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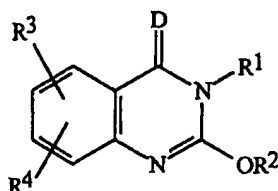
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(21) International Application Number: PCT/US98/01381 (22) International Filing Date: 26 January 1998 (26.01.98) (30) Priority Data: 60/036,063 30 January 1997 (30.01.97) US (71) Applicant (for all designated States except US): E.I. DU PONT DE NEMOURS AND COMPANY [US/US]; 1007 Market Street, Wilmington, DE 19898 (US). (72) Inventors; and (75) Inventors/Applicants (for US only): CROMPTON, Martina, Cajnar [US/US]; 6178 Telegraph Road, Elkton, MD 21921 (US). FOOR, Stephen, Ray [US/US]; 508 Hemingway Drive, Hockessin, DE 19707 (US). JULIS, Anthony, Jay [US/US]; 2706 Doris Drive, Wilmington, DE 19803 (US). (74) Agent: HEISER, David, E.; E.I. du Pont de Nemours and Company, Legal Patent Records Center, 1007 Market Street, Wilmington, DE 19898 (US).	(81) Designated States: AL, AM, AU, AZ, BA, BB, BG, BR, BY, CA, CN, CU, CZ, EE, GE, GW, HU, ID, IL, IS, JP, KG, KP, KR, KZ, LC, LK, LR, LT, LV, MD, MG, MK, MN, MX, NO, NZ, PL, RO, RU, SG, SI, SK, SL, TJ, TM, TR, TT, UA, US, UZ, VN, YU, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	

(54) Title: FUNGICIDAL MIXTURES

(57) Abstract

Advantageous combinations are disclosed comprising (1) at least one compound selected from the quinazolinones of Formula (I), *N*-oxides and agriculturally suitable salts thereof and (2) at least one compound selected from: (a) compounds acting at the *bc₁* complex of the fungal mitochondrial respiratory electron transfer site and (b) compounds that control fungal disease by inhibiting sterol biosynthesis. D is O or S and R¹-R⁴ are as defined in the disclosure. Included are fungicidal

compositions comprising fungicidally effective amounts of the compound combinations of the invention and a method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof, or to the plant seed or seedling, a fungicidally effective amount of the compound combinations of the invention.



(I)

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TITLE

FUNGICIDAL MIXTURES

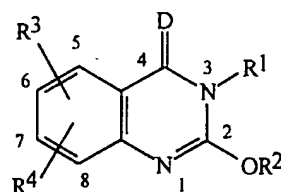
BACKGROUND OF THE INVENTION

5 Fungicides that effectively control plant diseases are in constant demand by growers. Plant diseases are highly destructive, difficult to control and quickly develop resistance to commercial fungicides. Combinations of pesticides are often used to facilitate disease control, to broaden spectrum of control and to retard resistance development. It is recognized in the art that the advantages of particular pesticide combinations can often vary, depending on such factors as the particular plant and plant
10 disease to be treated, and the treatment conditions. Accordingly, there is an ongoing search for advantageous combinations of pesticides.

International Patent Application WO 94/26722 discloses certain quinazolinone compounds as fungicides (e.g., 6-bromo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone, 6,8-diiodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and 6-iodo-3-propyl-2-
15 propyloxy-4(3*H*)-quinazolinone). International Patent Application WO 95/14009 discloses certain triazolone fungicides (e.g., 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]-methyl]phenyl]-3*H*-1,2,4-triazol-3-one). Kresoxim-methyl (BAS 490F) is a fungicide under consideration for the control of plant diseases, especially fungal diseases of wheat, grapes and fruits. (See E.
20 Ammermann, G. Lorenz, K. Schelberger, B. Wenderoth, H. Sauter and C. Rentzea "BAS 490F - A Broad-Spectrum Fungicide with a New Mode of Action" in *Brighton Crop Protection Conference - Pests and Diseases* - 1992, 1, 403-410.) Azoxystrobin (ICIA5504) is a fungicide under consideration for the control of plant diseases on a wide range of crops. (See J. R. Godwin, V. M. Anthony, J. M. Clough and C. R. A. Godfrey
25 "ICIA5504: A Novel, Broad Spectrum, Systemic β -Methoxyacrylate Fungicide" in *Brighton Crop Protection Conference - Pests and Diseases* - 1992, 1, 435-442.) European Patent Application EP-A-398,692 discloses (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide also known as SSF 126. This fungicide is under consideration for the control of plant disease, especially of rice. EP-A-68813 discloses
30 certain triazole compounds as fungicides (e.g., flusilazole). EP-A-40345 discloses certain triazole compounds as fungicides (e.g., tebuconazole).

SUMMARY OF THE INVENTION

This invention is directed to fungicidal combinations (e.g., mixtures) comprising (1) at least one compound selected from the quinazolinones of Formula I (including all geometric and stereoisomers), *N*-oxides, and agriculturally suitable salts thereof,



I

wherein

D is O or S;

R¹ is C₁-C₁₀ alkyl; C₃-C₅ cycloalkyl; C₃-C₁₀ alkenyl; C₃-C₁₀ alkynyl;

C₁-C₁₀ haloalkyl; C₃-C₁₀ haloalkenyl; C₃-C₁₀ haloalkynyl;

C₂-C₁₀ alkoxyalkyl; C₂-C₁₀ alkylthioalkyl; C₂-C₁₀ alkylsulfinylalkyl;

C₂-C₁₀ alkylsulfonylalkyl; C₄-C₁₀ cycloalkylalkyl;

C₄-C₁₀ alkenyloxyalkyl; C₄-C₁₀ alkynyloxyalkyl; C₄-C₁₀

(cycloalkyl)oxyalkyl; C₄-C₁₀ alkenylthioalkyl; C₄-C₁₀ alkynylthioalkyl;

C₄-C₁₀ (cycloalkyl)thioalkyl; C₂-C₁₀ haloalkoxyalkyl;

C₄-C₁₀ haloalkenyloxyalkyl; C₄-C₁₀ haloalkynyloxyalkyl;

C₄-C₁₀ alkoxyalkenyl; C₄-C₁₀ alkoxyalkynyl; C₄-C₁₀ alkylthioalkenyl;

C₄-C₁₀ alkylthioalkynyl; C₄-C₁₀ trialkylsilylalkyl; C₁-C₁₀ alkyl substituted

with NR⁵R⁶, nitro, cyano or phenyl optionally substituted with R⁸, R⁹ and

R¹⁰; C₁-C₁₀ alkoxy; C₁-C₁₀ haloalkoxy; C₁-C₁₀ alkylthio;

C₁-C₁₀ haloalkylthio; or pyridinyl, furanyl, thienyl, naphthalenyl,

benzofuranyl, benzothienyl or quinolinyl each optionally substituted with R⁸, R⁹ and R¹⁰;

R² is C₁-C₁₀ alkyl; C₃-C₇ cycloalkyl; C₃-C₁₀ alkenyl; C₃-C₁₀ alkynyl;

C₁-C₁₀ haloalkyl; C₃-C₁₀ haloalkenyl; C₃-C₁₀ haloalkynyl;

C₂-C₁₀ alkoxyalkyl; C₂-C₁₀ alkylthioalkyl; C₂-C₁₀ alkylsulfinylalkyl;

C₂-C₁₀ alkylsulfonylalkyl; C₄-C₁₀ cycloalkylalkyl;

C₄-C₁₀ alkenyloxyalkyl; C₄-C₁₀ alkynyloxyalkyl; C₄-C₁₀

(cycloalkyl)oxyalkyl; C₄-C₁₀ alkenylthioalkyl; C₄-C₁₀ alkynylthioalkyl;

C₄-C₁₀ (cycloalkyl)thioalkyl; C₂-C₁₀ haloalkoxyalkyl;

C₄-C₁₀ haloalkenyloxyalkyl; C₄-C₁₀ haloalkynyloxyalkyl;

C₄-C₁₀ alkoxyalkenyl; C₄-C₁₀ alkoxyalkynyl; C₄-C₁₀ alkylthioalkenyl;

C₄-C₁₀ alkylthioalkynyl; C₄-C₁₀ trialkylsilylalkyl; C₂-C₁₀ cyanoalkyl;

C₁-C₁₀ nitroalkyl; C₁-C₁₀ alkyl substituted with CO₂R⁵, NR⁵R⁶, or phenyl optionally substituted with R⁷, R⁹ and R¹⁰; phenyl optionally substituted with R⁷, R⁹ and R¹⁰; -N=CR⁵R⁵; or -NR⁵R⁶; or

R¹ and R² are taken together to form -CH₂(CH₂)_qCH₂-;

5 q is 0, 1, 2, 3 or 4;

R³ is halogen, C₁-C₈ alkyl, C₃-C₈ cycloalkyl, C₂-C₈ alkenyl, C₂-C₈ alkynyl, C₁-C₈ haloalkyl, C₃-C₈ haloalkenyl, C₃-C₈ haloalkynyl, C₁-C₈ alkoxy, C₁-C₈ haloalkoxy, C₃-C₈ alkenyloxy, C₃-C₈ alkynyloxy, C₁-C₈ alkylthio, C₃-C₈ alkenylthio, C₃-C₈ alkynylthio, C₁-C₈ alkylsulfinyl, C₁-C₈ alkylsulfonyl, C₂-C₈ alkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₄-C₈ cycloalkylalkyl, C₃-C₈ trialkylsilyl, NR⁵R⁶, C₅-C₈ trialkylsilylalkynyl or phenyl optionally substituted with at least one R⁷;

10 R⁴ is hydrogen, halogen, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy or C₁-C₄ haloalkoxy;

each R⁵ is independently hydrogen, C₁-C₄ alkyl or phenyl optionally substituted with at least one R⁷;

each R⁶ is independently hydrogen, C₁-C₈ alkyl or phenyl optionally substituted with at least one R⁷; or

20 when R⁵ and R⁶ are attached to the same nitrogen atom, R⁵ and R⁶ can be taken together to form -CH₂CH₂CH₂CH₂-, -CH₂(CH₂)₃CH₂-, -CH₂CH₂OCH₂CH₂-, -CH₂CH(Me)CH₂CH(Me)CH₂- or -CH₂CH(Me)OCH(Me)CH₂-;

25 each R⁷ is independently halogen, C₁-C₄ alkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkyl, nitro or cyano;

R⁸ is C₁-C₆ alkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkyl, halogen, C₂-C₈ alkynyl, C₁-C₆ alkylthio, phenyl or phenoxy each optionally substituted with at least one R⁷, cyano, nitro, C₁-C₆ haloalkoxy, C₁-C₆ haloalkylthio, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, acetyl, CO₂Me or N(C₁-C₂ alkyl)₂;

30 each R⁹ is independently methyl, ethyl, methoxy, methylthio, halogen or trifluoromethyl; and

each R¹⁰ is independently halogen;

and (2) at least one compound selected from (a) compounds acting at the bc₁ complex of the fungal mitochondrial respiratory electron transfer site and (b) compounds that control fungal disease by inhibiting the sterol biosynthesis pathway. This invention provides agricultural compositions containing these combinations and the use of the combinations as fungicides. Advantageous compositions include those where component (1) and component (2) are present in a fungicidally effective amount and the

mole ratio of component (1) to component (2) is from about 30:1 to 1:30.

Advantageous methods include those where component (1) and component (2) are added in amounts sufficient to provide a fungicidal effectiveness greater than the sum of the fungicidal effectivenesses provided by those amounts of said components taken independently.

DETAILS OF THE INVENTION

Combinations of fungicides are used in accordance with this invention to facilitate disease control and to retard resistance development. Suitable compositions and methods are provided.

For example, this invention also provides methods for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof to be protected, or to the plant seed or seedling to be protected one of the following:

- A) an effective amount of a fungicidal composition comprising component (1), component (2), and at least one of a surfactant, a solid diluent or a liquid diluent;
- 15 B) (i) an effective amount of a first composition comprising component (1), and at least one of a surfactant, solid or liquid diluent; and (ii) an effective amount of a second composition comprising component (2), and at least one of a surfactant, a solid diluent or a liquid diluent; said first and second compositions applied sequentially in any order; or
- 20 C) an effective amount of a physical mixture of the first and second compositions as defined in B above.

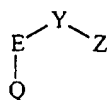
The mole ratio of the compound(s) of component (1) to the compound(s) of component (2) applied is normally from about 30:1 to 1:30, and the compound(s) of component (1) and the compound(s) of component (2) are normally applied in amounts effective to provide control of the fungal disease which is greater than the additive control of that fungal disease provided by the compound(s) of component (1) and the compound(s) of component (2) individually.

Preferred compositions for reasons of ease of synthesis or greater fungicidal activity are:

- 30 Preferred 1. A fungicidal composition comprising a fungicidally effective amount of (1) at least one quinazolinone of Formula I (including all geometric and stereoisomers), *N*-oxides, and agriculturally suitable salts thereof, wherein
 - R¹ is C₁-C₆ alkyl;
 - R² is C₁-C₆ alkyl;
 - 35 R³ is halogen and fixed at position 6 of the quinazolinone; and
 - R⁴ is hydrogen or halogen and fixed at position 8 of the quinazolinone;
 - and (2) at least one compound selected from

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(a) compounds of Formula II (including all geometric and stereoisomers),
N-oxides, and agriculturally suitable salts thereof,

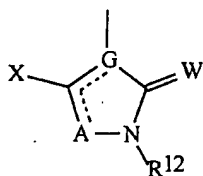


II

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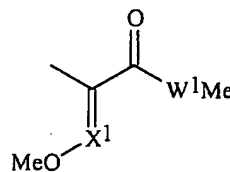
wherein

Q is



Q-1

or



Q-2

10

E is selected from:

i) 1,2-phenylene optionally substituted with R^{13} or both R^{13} and R^{14} ;

ii) a naphthalene ring, provided that when G and Y are attached to the same ring, then G and Y are attached to adjacent ring members, the naphthalene ring optionally substituted with R^{13} or both R^{13} and R^{14} ; and

iii) a ring system selected from 5 to 12-membered monocyclic and fused bicyclic aromatic heterocyclic ring systems, each heterocyclic ring system containing 1 to 6 heteroatoms independently selected from the group nitrogen, oxygen, and sulfur, provided that each heterocyclic ring system contains no more than 4 nitrogens, no more than 2 oxygens, and no more than 2 sulfurs, each fused bicyclic ring system optionally containing one nonaromatic ring that optionally includes one or two J^1 as ring members and optionally includes one or two ring members independently selected from $C(=O)$ and $S(O)_2$, provided that G is attached to an aromatic ring, and when G and Y are attached to the same ring, then G and Y are attached to adjacent ring members, each aromatic

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heterocyclic ring system optionally substituted with R¹³ or both R¹³ and R¹⁴;

A is O, S, N, NR¹⁵ or CR²⁴;

G is C or N; provided that when G is C, then A is O, S or NR¹⁵ and the floating double bond is attached to G; and when G is N, then A is N or CR²⁴ and the floating double bond is attached to A;

W is O, S, NH, N(C₁-C₆ alkyl) or NO(C₁-C₆ alkyl);

W¹ is O or NH;

X is H, OR¹¹, S(O)_mR¹¹, halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₃-C₆ cycloalkyl, cyano, NH₂, NHR¹¹, N(C₁-C₆ alkyl)R¹¹, NH(C₁-C₆ alkoxy) or N(C₁-C₆ alkoxy)R¹¹;

X¹ is CH or N;

R¹¹ is C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₃-C₆ cycloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxycarbonyl;

R¹² is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₃-C₆ cycloalkyl, C₂-C₄ alkylcarbonyl, C₂-C₄ alkoxycarbonyl, hydroxy, C₁-C₂ alkoxy or acetyloxy;

R¹³ and R¹⁴ are each independently halogen; cyano; nitro; hydroxy; C₁-C₆ alkyl; C₁-C₆ haloalkyl; C₂-C₆ alkenyl; C₂-C₆ haloalkenyl; C₂-C₆ alkynyl; C₂-C₆ haloalkynyl; C₁-C₆ alkoxy; C₁-C₆ haloalkoxy; C₂-C₆ alkenyloxy; C₂-C₆ alkynyloxy; C₁-C₆ alkylthio; C₁-C₆ alkylsulfinyl; C₁-C₆ alkylsulfonyl; formyl; C₂-C₆ alkylcarbonyl; C₂-C₆ alkoxycarbonyl; NH₂C(O); (C₁-C₄ alkyl)NHC(O); (C₁-C₄ alkyl)₂NC(O); Si(R³⁵)₃; Ge(R³⁵)₃; (R³⁵)₃Si-C≡C-; or phenyl, phenylethynyl, benzoyl, or phenylsulfonyl each substituted with R¹⁸ and optionally substituted with one or more R²⁰; or

when E is 1,2-phenylene and R¹³ and R¹⁴ are attached to adjacent atoms, R¹³ and R¹⁴ can be taken together as C₃-C₅ alkylene, C₃-C₅ haloalkylene, C₃-C₅ alkenylene or C₃-C₅ haloalkenylene each optionally substituted with 1-2 C₁-C₃ alkyl;

R¹⁵ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₃-C₆ cycloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxycarbonyl;

Y is -O-, -S(O)_n-, -NR²⁵-, -C(=O)-, -CH(OR²⁵)-, -CHR¹⁶-, -CHR¹⁶CHR¹⁶-, -CR¹⁶=CR¹⁶-, -C≡C-, -CHR²⁵O-, -OCHR²⁵-,

- CHR²⁵S(O)_n-, -S(O)_nCHR²⁵-, -CHR²⁵O-N=C(R¹⁷)-,
 -(R¹⁷)C=N-OCH(R²⁵)-, -C(R¹⁷)=N-O-, -O-N=C(R¹⁷)-,
 -CHR²⁵OC(=O)N(R²⁵)-, -CHR²⁵OC(=S)N(R²⁵)-,
 -CHR²⁵OC(=O)O-, -CHR²⁵OC(=S)O-, -CHR²⁵OC(=O)S-,
 -CHR²⁵OC(=S)S-, -CHR²⁵SC(=O)N(R²⁵)-,
 -CHR²⁵SC(=S)N(R²⁵)-, -CHR²⁵SC(=O)O-, -CHR²⁵SC(=S)O-,
 -CHR²⁵SC(=O)S-, -CHR²⁵SC(=S)S-, -CHR²⁵SC(=NR²⁵)S-,
 -CHR²⁵N(R²⁵)C(=O)N(R²⁵)-, -CHR²⁵O-N(R²⁵)C(=O)N(R²⁵)-,
 -CHR²⁵O-N(R²⁵)C(=S)N(R²⁵)-, -CHR²⁵O-N=C(R¹⁷)NR²⁵-,
 -CHR²⁵O-N=C(R¹⁷)OCH₂-, -CHR²⁵O-N=C(R¹⁷)-N=N-,
 -CHR²⁵O-N=C(R¹⁷)-C(=O)-,
 -CHR²⁵O-N=C(R¹⁷)-C(=N-A²-Z¹)-A¹-,
 -CHR²⁵O-N=C(R¹⁷)-C(R¹⁷)=N-A²-A³-,
 -CHR²⁵O-N=C(-C(R¹⁷)=N-A²-Z¹)-, -CHR²⁵O-N=C(R¹⁷)-CH₂O-,
 -CHR²⁵O-N=C(R¹⁷)-CH₂S-, -O-CH₂CH₂O-N=C(R¹⁷)-,
 -CHR²⁵O-C(R²⁵)=C(R¹⁷)-, -CHR²⁵O-C(R¹⁷)=N-,
 -CHR²⁵S-C(R¹⁷)=N-, -C(R¹⁷)=N-NR²⁵-, -CH=N-N=C(R¹⁷)-,
 -CHR²⁵N(R²⁵)-N=C(R¹⁷)-, -CHR²⁵N(COCH₃)-N=C(R¹⁷)-,
 -OC(=S)NR²⁵C(=O)-, -CHR¹⁶-C(=W²)-A¹-,
 -CHR¹⁶CHR¹⁶-C(=W²)-A¹-, -CR¹⁶=CR¹⁶-C(=W²)-A¹-,
 -C≡C-C(=W²)-A¹-, -N=CR¹⁶-C(=W²)-A¹- or a direct bond; and
 the directionality of the Y linkage is defined such that the moiety
 depicted on the left side of the linkage is bonded to E and the
 moiety on the right side of the linkage is bonded to Z;
- Z¹ is H or -A³-Z;
- W² is O or S;
- A¹ is O, S, NR²⁵ or a direct bond;
- A² is O, NR²⁵ or a direct bond;
- A³ is -C(=O)-, -S(O)₂- or a direct bond;
- each R¹⁶ is independently H, 1-2 CH₃, C₂-C₃ alkyl, C₁-C₃ alkoxy,
 C₃-C₆ cycloalkyl, formylamino, C₂-C₄ alkylcarbonylamino,
 C₂-C₄ alkoxycarbonylamino, NH₂C(O)NH,
 (C₁-C₃ alkyl)NHC(O)NH, (C₁-C₃ alkyl)₂NC(O)NH,
 N(C₁-C₃ alkyl)₂, piperidinyl, morpholinyl, 1-2 halogen, cyano or
 nitro;
- each R¹⁷ is independently H, C₁-C₆ alkyl, C₁-C₆ haloalkyl,
 C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₁-C₆ alkylthio,
 C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylthio,

C₁-C₆ haloalkylsulfinyl, C₁-C₆ haloalkylsulfonyl, C₂-C₆ alkenyl,
C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl,
C₃-C₆ cycloalkyl, C₂-C₄ alkylcarbonyl, C₂-C₄ alkoxy carbonyl,
halogen, cyano, nitro, hydroxy, amino, NH(C₁-C₆ alkyl),
N(C₁-C₆ alkyl)₂ or morpholinyl;

each Z is independently selected from:

i) C₁-C₁₀ alkyl, C₂-C₁₀ alkenyl and C₂-C₁₀ alkynyl each
substituted with R¹⁹ and optionally substituted with one or more
R²⁰;

ii) C₃-C₈ cycloalkyl, C₃-C₈ cycloalkenyl and phenyl each
substituted with R¹⁹ and optionally substituted with one or more
R²⁰;

iii) a ring system selected from 3 to 14-membered monocyclic,
fused bicyclic and fused tricyclic nonaromatic heterocyclic ring
systems and 5 to 14-membered monocyclic, fused bicyclic and
fused tricyclic aromatic heterocyclic ring systems, each
heterocyclic ring system containing 1 to 6 heteroatoms
independently selected from the group nitrogen, oxygen, and sulfur,
provided that each heterocyclic ring system contains no more than
4 nitrogens, no more than 2 oxygens, and no more than 2 sulfurs,
each nonaromatic or aromatic heterocyclic ring system substituted
with R¹⁹ and optionally substituted with one or more R²⁰;

iv) a multicyclic ring system selected from 8 to 14-membered
fused-bicyclic and fused-tricyclic ring systems which are an
aromatic carbocyclic ring system, a nonaromatic carbocyclic ring
system, or a ring system containing one or two nonaromatic rings
that each include one or two J¹ as ring members and one or two
ring members independently selected from C(=O) and S(O)₂, and
any remaining rings as aromatic carbocyclic rings, each multicyclic
ring system substituted with R¹⁹ and optionally substituted with
one or more R²⁰; and

v) adamantyl substituted with R¹⁹ and optionally substituted with
one or more R²⁰;

each J¹ is independently selected from the group -CHR²³-, -NR²³-, -O-
and -S(O)_p-;

R¹⁸ is H, 1-2 halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₁-C₆ alkoxy,
C₁-C₆ haloalkoxy, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl,
C₂-C₆ alkynyl, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio,

- C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₃-C₆ cycloalkyl,
 C₃-C₆ alkenyloxy, CO₂(C₁-C₆ alkyl), NH(C₁-C₆ alkyl),
 N(C₁-C₆ alkyl)₂, cyano, nitro, SiR²⁹R³⁰R³¹ or GeR²⁹R³⁰R³¹;
 R¹⁹ is H; 1-2 halogen; C₁-C₆ alkyl; C₁-C₆ haloalkyl; C₁-C₆ alkoxy;
 5 C₁-C₆ haloalkoxy; C₂-C₆ alkenyl; C₂-C₆ haloalkenyl;
 C₂-C₆ alkynyl; C₁-C₆ alkylthio; C₁-C₆ haloalkylthio;
 C₁-C₆ alkylsulfinyl; C₁-C₆ alkylsulfonyl; C₃-C₆ cycloalkyl;
 C₃-C₆ alkenyloxy; CO₂(C₁-C₆ alkyl); NH(C₁-C₆ alkyl);
 N(C₁-C₆ alkyl)₂; -C(R²⁸)=NOR²⁷; cyano; nitro; SF₅;
 10 SiR³²R³³R³⁴; or GeR³²R³³R³⁴; or R¹⁹ is phenyl, benzyl, benzoyl,
 phenoxy, pyridinyl, pyridinyloxy, thienyl, thienyloxy, furanyl,
 pyrimidinyl or pyrimidinyloxy each optionally substituted with R²¹
 or both R²¹ and R²²;
 each R²⁰ is independently halogen, C₁-C₄ alkyl, C₁-C₄ haloalkyl,
 15 C₁-C₄ alkoxy, nitro or cyano; or
 when R¹⁹ and an R²⁰ are attached to adjacent atoms on Z, R¹⁹ and said
 adjacently attached R²⁰ can be taken together as -OCH₂O- or
 -OCH₂CH₂O-; each CH₂ group of said taken together R¹⁹ and R²⁰
 optionally substituted with 1-2 halogen; or
 20 when Y and an R²⁰ are attached to adjacent atoms on Z and Y is
 -CHR²⁵O-N=C(R¹⁷)-, -O-N=C(R¹⁷)-, -O-CH₂CH₂O-N=C(R¹⁷)-,
 -CHR²⁵O-C(R²⁵)=C(R¹⁷)-, -CH=N-N=C(R¹⁷)-,
 -CHR²⁵N(R²⁵)-N=C(R¹⁷)- or -CHR²⁵N(COCH₃)-N=C(R¹⁷)-, R¹⁷
 and said adjacently attached R²⁰ can be taken together as
 25 -(CH₂)_r-J- such that J is attached to Z;
 J is -CH₂-, -CH₂CH₂-, -OCH₂-, -CH₂O-, -SCH₂-, -CH₂S-, -N(R²⁶)CH₂-
 or -CH₂N(R²⁶)-; each CH₂ group of said J optionally substituted
 with 1 to 2 CH₃;
 R²¹ and R²² are each independently 1-2 halogen; C₁-C₄ alkyl;
 30 C₁-C₄ haloalkyl; C₂-C₆ alkenyl; C₂-C₆ haloalkenyl; C₂-C₆
 alkynyl; C₂-C₆ haloalkynyl; C₂-C₆ alkoxyalkyl; C₂-C₆
 alkylthioalkyl; C₃-C₆ alkoxyalkynyl;
 C₇-C₁₀ tetrahydropyranyloxyalkynyl; benzyloxymethyl; C₁-C₄
 alkoxy; C₁-C₄ haloalkoxy; C₃-C₆ alkenyloxy; C₃-C₆
 35 haloalkenyloxy; C₃-C₆ alkynyloxy; C₃-C₆ haloalkynyloxy; C₂-C₆
 alkoxyalkoxy; C₅-C₉ trialkylsilylalkoxyalkoxy;
 C₂-C₆ alkylthioalkoxy; C₁-C₄ alkylthio; C₁-C₄ haloalkylthio;
 C₁-C₄ alkylsulfinyl; C₁-C₄ haloalkylsulfinyl; C₁-C₄ alkylsulfonyl;

C_1 - C_4 haloalkylsulfonyl; C_3 - C_6 alkenylthio;
 C_3 - C_6 haloalkenylthio; C_2 - C_6 alkylthioalkylthio; nitro; cyano;
 thiocyanato; hydroxy; $N(R^{36})_2$; SF_5 ; $Si(R^{35})_3$; $Ge(R^{35})_3$;
 $(R^{35})_3Si-C\equiv C$; $OSi(R^{35})_3$; $OGe(R^{35})_3$; $C(=O)R^{36}$; $C(=S)R^{36}$;
 5 $C(=O)OR^{36}$; $C(=S)OR^{36}$; $C(=O)SR^{36}$; $C(=S)SR^{36}$; $C(=O)N(R^{36})_2$;
 $C(=S)N(R^{36})_2$; $OC(=O)R^{36}$; $OC(=S)R^{36}$; $SC(=O)R^{36}$; $SC(=S)R^{36}$;
 $N(R^{36})C(=O)R^{36}$; $N(R^{36})C(=S)R^{36}$; $OC(=O)OR^{37}$; $OC(=O)SR^{37}$;
 $OC(=O)N(R^{36})_2$; $SC(=O)OR^{37}$; $SC(=O)SR^{37}$; $S(O)_2OR^{36}$;
 $S(O)_2N(R^{36})_2$; $OS(O)_2R^{37}$; $N(R^{36})S(O)_2R^{37}$; or phenyl, phenoxy,
 10 benzyl, benzyloxy, phenylsulfonyl, phenylethynyl or
 pyridinylethynyl, each optionally substituted with halogen,
 C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_1 - C_4 alkoxy, C_1 - C_4 haloalkoxy,
 nitro or cyano;
 each R^{23} is independently H; C_1 - C_6 alkyl; C_1 - C_6 haloalkyl; or phenyl
 15 optionally substituted with halogen, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl,
 C_1 - C_4 alkoxy, C_1 - C_4 haloalkoxy, nitro or cyano;
 R^{24} is H, halogen, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_2 - C_6 alkenyl,
 C_2 - C_6 haloalkenyl, C_2 - C_6 alkynyl, C_2 - C_6 haloalkynyl or
 C_3 - C_6 cycloalkyl;
 20 each R^{25} is independently H; C_1 - C_3 alkyl; C_3 - C_6 cycloalkyl; or phenyl or
 benzyl, each optionally substituted on the phenyl ring with halogen,
 C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_1 - C_4 alkoxy, C_1 - C_4 haloalkoxy,
 nitro or cyano; or
 when Y is $-CHR^{25}N(R^{25})C(=O)N(R^{25})-$, the two R^{25} attached to
 25 nitrogen atoms on said group can be taken together as $-(CH_2)_s-$; or
 when Y is $-CHR^{25}O-N=C(R^{17})NR^{25}-$, R^{17} and the adjacently attached
 R^{25} can be taken together as $-CH_2-(CH_2)_s-$, $-O-(CH_2)_s-$,
 $-S-(CH_2)_s-$ or $-N(C_1-C_3 \text{ alkyl})-(CH_2)_s-$; with the directionality of
 said linkage defined such that the moiety depicted on the left side
 30 of the linkage is bonded to the carbon and the moiety on the right
 side of the linkage is bonded to the nitrogen;
 R^{26} , R^{27} and R^{28} are each independently H; C_1 - C_3 alkyl;
 C_3 - C_6 cycloalkyl; or phenyl optionally substituted with halogen,
 C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_1 - C_4 alkoxy, C_1 - C_4 haloalkoxy,
 35 nitro or cyano;
 R^{29} , R^{30} , R^{31} , R^{32} , R^{33} and R^{34} are each independently C_1 - C_6 alkyl,
 C_2 - C_6 alkenyl, C_1 - C_4 alkoxy or phenyl;

each R³⁵ is independently C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₁-C₄ alkoxy or phenyl;

each R³⁶ is independently H; C₁-C₆ alkyl; C₁-C₆ haloalkyl;

C₂-C₆ alkenyl; C₂-C₆ haloalkenyl; C₂-C₆ alkynyl;

5 C₂-C₆ haloalkynyl; C₃-C₆ cycloalkyl; or phenyl or benzyl, each optionally substituted on the phenyl ring with halogen, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, nitro or cyano;

each R³⁷ is independently C₁-C₆ alkyl; C₁-C₆ haloalkyl; C₂-C₆ alkenyl;

C₂-C₆ haloalkenyl; C₂-C₆ alkynyl; C₂-C₆ haloalkynyl;

10 C₃-C₆ cycloalkyl; or phenyl or benzyl, each optionally substituted on the phenyl ring with halogen, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, nitro or cyano;

m, n and p are each independently 0, 1 or 2;

r is 0 or 1; and

15 s is 2 or 3;

and (b) bromuconazole, cyproconazole, difenoconazole, diniconazole, epoxiconazole, fenarimol, fenbuconazole, fenpropidin, fenpropimorph, fluquinconazole, flusilazole, flutriafol, hexaconazole, ipconazole, metconazole, penconazole, propiconazole, tebuconazole, tetraconazole, triadimefon, triadimenol, tridemorph, triticonazole and uniconazole.

Preferred 2. The fungicidal composition of Preferred 1 comprising a fungicidally effective amount of (1) at least one compound selected from the group consisting of

25 6-bromo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone, 6,8-diiodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone;

and (2) at least one compound selected from the group consisting of

30 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole and tebuconazole.

35 Preferred 3. The fungicidal composition of Preferred 2 comprising a fungicidally effective amount of (1) 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone (sometimes referred to hereafter as the Formula Ia compound) and (2) 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-

(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one (sometimes referred to hereafter as the Formula IIa compound).

5 Preferred 4. The fungicidal composition of Preferred 2 comprising a fungicidally effective amount of (1) 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and (2) flusilazole.

Preferred 5. The fungicidal composition of Preferred 2 comprising a fungicidally effective amount of (1) 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and (2) tebuconazole.

10 Preferred 6. The fungicidal composition of Preferred 2 comprising a fungicidally effective amount of (1) 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone, and (2) both 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one and flusilazole.

15 In the above recitations, the term "alkyl", used either alone or in compound words such as "alkylthio" or "haloalkyl" includes straight-chain or branched alkyl, such as, methyl, ethyl, *n*-propyl, *i*-propyl, or the different butyl, pentyl, hexyl, heptyl, octyl, nonyl and decyl isomers. The term "1-2 CH₃" indicates that the substituent can be methyl (i.e., Me) or, when there is a hydrogen attached to the same atom, the substituent
20 and said hydrogen can both be methyl. "Alkenyl" includes straight-chain or branched alkenes such as ethenyl, 1-propenyl, 2-propenyl, and the different butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl and decenyl isomers. "Alkenyl" also includes polyenes such as 1,2-propadienyl and 2,4-hexadienyl. "Alkynyl" includes straight-chain or branched alkynes such as ethynyl, 1-propynyl, 2-propynyl and the different butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, and decynyl isomers. "Alkynyl" can
25 also include moieties comprised of multiple triple bonds such as 2,5-hexadiynyl.

"Alkylene" denotes a straight-chain or branched alkanediyl. Examples of "alkylene" include CH₂CH₂CH₂, CH₂CH(CH₃) and the different butylene and pentylene isomers. "Haloalkylene" denotes a halogen substituted alkylene. Examples
30 of "haloalkylene" include CH₂CH(CF₃), CH₂CF₂CH₂ and CH₂CH(CCl₃).

"Alkenylene" denotes a straight-chain or branched alkenediyl containing one olefinic bond. Examples of "alkenylene" include CH₂CH=CH and CH=C(CH₃) and the different butenylene and pentenylene isomers. "Haloalkenylene" denotes a halogen substituted alkenylene. Examples of "haloalkenylene" include CH₂CCl=CCl and
35 CH=C(CF₃).

"Alkenyloxyalkyl" denotes alkenyl substitution on oxygen which in turn is substituted on alkyl. Examples "alkenyloxyalkyl" include CH₂=CHCH₂OCH₂ and CH₃CH=CHCH₂OCH₂CH₂. "Alkynyloxyalkyl" denotes alkynyl substitution on

oxygen which in turn is substituted on alkyl. Examples of "alkynyloxyalkyl" include $\text{CH}\equiv\text{CCH}_2\text{OCH}_2$ and $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{OCH}_2\text{CH}_2$.

- "Alkoxy" includes, for example, methoxy, ethoxy, propyloxy, 1-methylethoxy and the different butoxy, pentyloxy, hexyloxy, heptyloxy, octyloxy, nonyloxy, and decyloxy isomers. "Alkoxyalkyl" denotes alkoxy substitution on alkyl. Examples of "alkoxyalkyl" include CH_3OCH_2 , $\text{CH}_3\text{OCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{OCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_2$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2$. "Alkoxyalkoxy" denotes alkoxy substitution on alkoxy. Examples of "alkoxyalkoxy" include $\text{CH}_3\text{OCH}_2\text{O}$, $(\text{CH}_3)_3\text{COCH}_2\text{O}$ and $\text{CH}_3\text{OCH}_2\text{CH}_2\text{O}$. "Alkenyloxy" includes straight-chain or branched alkenyloxy moieties. Examples of "alkenyloxy" include $\text{H}_2\text{C}=\text{CHCH}_2\text{O}$, $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{O}$, $(\text{CH}_3)\text{CH}=\text{CHCH}_2\text{O}$, $(\text{CH}_3)\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{O}$ and $\text{CH}_2=\text{CHCH}_2\text{CH}_2\text{O}$. "Alkynyloxy" includes straight-chain or branched alkynyloxy moieties. Examples of "alkynyloxy" include $\text{HC}\equiv\text{CCH}_2\text{O}$, $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{O}$ and $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{CH}_2\text{O}$. "Alkoxyalkenyl" denotes alkoxy substitution of alkenyl.
- "Alkoxyalkenyl" includes straight-chain or branched alkoxyalkenyl moieties. Examples of "alkoxyalkenyl" include $(\text{CH}_3)_2\text{CHOCH}=\text{CH}$ and $\text{CH}_3\text{OCH}_2\text{CH}=\text{CH}$. "Alkoxyalkynyl" denotes alkoxy substitution of alkynyl. "Alkoxyalkynyl" includes straight-chain or branched alkoxyalkynyl moieties. Examples of "alkoxyalkynyl" include $(\text{CH}_3)_2\text{CHOCH}_2\text{C}\equiv\text{C}$ and $\text{CH}_3\text{OCH}_2\text{C}\equiv\text{C}$.
- "Alkylthio" includes branched or straight-chain alkylthio moieties such as methylthio, ethylthio, and the different propylthio, butylthio, pentylthio, hexylthio, heptylthio, octylthio, nonylthio and decylthio isomers. "Alkylthioalkyl" denotes alkylthio substitution on alkyl. Examples of "alkylthioalkyl" include CH_3SCH_2 , $\text{CH}_3\text{SCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{SCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{SCH}_2$ and $\text{CH}_3\text{CH}_2\text{SCH}_2\text{CH}_2$.
- "Alkylthioalkoxy" denotes alkylthio substitution on alkoxy. Examples of "alkylthioalkoxy" include $\text{CH}_3\text{SCH}_2\text{O}$ and $\text{CH}_3\text{CH}_2\text{SCH}_2\text{CH}_2\text{O}$. "Alkylthioalkylthio" denotes alkylthio substitution on alkylthio. Examples of "alkylthioalkylthio" include $\text{CH}_3\text{SCH}_2\text{S}$ and $\text{CH}_3\text{SCH}_2\text{CH}_2\text{S}$. "Alkylsulfinyl" includes both enantiomers of an alkylsulfinyl group. Examples of "alkylsulfinyl" include $\text{CH}_3\text{S}(\text{O})$, $\text{CH}_3\text{CH}_2\text{S}(\text{O})$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S}(\text{O})$, $(\text{CH}_3)_2\text{CHS}(\text{O})$ and the different butylsulfinyl, pentylsulfinyl, hexylsulfinyl, heptylsulfinyl and octylsulfinyl isomers. "Alkylsulfinylalkyl" denotes alkylsulfinyl substitution on alkyl. Examples of "alkylsulfinylalkyl" include $\text{CH}_3\text{S}(\text{O})\text{CH}_2$, $\text{CH}_3\text{S}(\text{O})\text{CH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{S}(\text{O})\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{S}(\text{O})\text{CH}_2$ and $\text{CH}_3\text{CH}_2\text{S}(\text{O})\text{CH}_2\text{CH}_2$. Examples of "alkylsulfonyl" include $\text{CH}_3\text{S}(\text{O})_2$, $\text{CH}_3\text{CH}_2\text{S}(\text{O})_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S}(\text{O})_2$, $(\text{CH}_3)_2\text{CHS}(\text{O})_2$ and the different butylsulfonyl, pentylsulfonyl, hexylsulfonyl, heptylsulfonyl and octylsulfonyl isomers.
- "Alkylsulfonylalkyl" denotes alkylsulfonyl substitution on alkyl. Examples of "alkylsulfonylalkyl" include $\text{CH}_3\text{S}(\text{O})_2\text{CH}_2$, $\text{CH}_3\text{S}(\text{O})_2\text{CH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{S}(\text{O})_2\text{CH}_2$,

$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{S}(\text{O})_2\text{CH}_2$ and $\text{CH}_3\text{CH}_2\text{S}(\text{O})_2\text{CH}_2\text{CH}_2$. "Alkylthioalkenyl" denotes alkylthio substitution on alkenyl. Examples of "alkylthioalkenyl" include $\text{CH}_3\text{SCH}_2\text{CH}=\text{CH}$ and $\text{CH}_3\text{CH}_2\text{SCH}=\text{CH}$. "Alkylthioalkynyl" denotes alkylthio substitution on alkynyl. Examples of "alkylthioalkynyl" include $\text{CH}_3\text{SCH}_2\text{C}\equiv\text{C}$ and

5 $\text{CH}_3\text{CH}_2\text{SCH}_2\text{CH}_2\text{C}\equiv\text{C}$. "Alkenylthio" includes straight-chain and branched alkenylthio moieties. Examples of "alkenylthio" include $\text{CH}_2=\text{CHCH}_2\text{S}$ and $\text{CH}_2=\text{CHCH}_2\text{CH}_2\text{S}$. "Alkenylthioalkyl" denotes alkenylthio substitution on alkyl. Examples of "alkenylthioalkyl" include $\text{CH}_2=\text{CHCH}_2\text{SCH}_2$ and $\text{CH}_2=\text{CHCH}_2\text{CH}_2\text{SCH}_2$. "Alkynylthio" includes straight-chain and branched

10 alkynylthio moieties. Examples of "alkynylthio" include $\text{CH}\equiv\text{CCH}_2\text{S}$ and $\text{CH}\equiv\text{CCH}_2\text{CH}_2\text{S}$. "Alkynylthioalkyl" denotes alkynylthio substitution on alkyl. Examples of "alkynylthioalkyl" include $\text{CH}\equiv\text{CCH}_2\text{SCH}_2$ and $\text{CH}\equiv\text{CCH}_2\text{CH}_2\text{SCH}_2$.

"Cycloalkyl" includes, for example, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl and cyclooctyl. "(Cycloalkyl)oxyalkyl" denotes cycloalkyl substituted on oxygen which in turn is substituted on alkyl. Examples of

15 "(cycloalkyl)oxyalkyl" include (cyclopentyloxy)methyl and (cyclohexyloxy)methyl. "(Cycloalkyl)thioalkyl" denotes cycloalkyl substituted on sulfur which in turn is substituted on alkyl. Examples of "(cycloalkyl)thioalkyl" include (cyclopentylthio)methyl and (cyclohexylthio)methyl. "Cycloalkenyl" includes groups

20 such as cyclopentenyl and cyclohexenyl as well as groups with more than one double bond such as 1,3- and 1,4-cyclohexadienyl. Examples of "cycloalkylalkyl" include cyclopropylmethyl, cyclopentylethyl, and other cycloalkyl moieties bonded to straight-chain or branched alkyl groups.

"Cyanoalkyl" denotes an alkyl group substituted with one cyano group. Examples

25 of "cyanoalkyl" include NCCH_2 , NCCH_2CH_2 and $\text{CH}_3\text{CH}(\text{CN})\text{CH}_2$. "Nitroalkyl" denotes an alkyl group substituted with one nitro group. Examples of "nitroalkyl" include NO_2CH_2 and $\text{CH}_3\text{CH}(\text{NO}_2)\text{CH}_2$.

"Tetrahydropyranyloxyalkynyl" denotes a tetrahydropyranyl group on oxygen which in turn is substituted on an alkynyl group. An example of

30 "tetrahydropyranyloxyalkynyl" is 2-[(tetrahydro-2H-pyranyl)oxy]ethynyl.

The term "aromatic ring system" denotes fully unsaturated carbocycles and heterocycles in which the polycyclic ring system is aromatic (where aromatic indicates that the Hückel rule is satisfied for the ring system). The term "aromatic carbocyclic ring system" includes fully aromatic carbocycles and carbocycles in which at least one

35 ring of a polycyclic ring system is aromatic (where aromatic indicates that the Hückel rule is satisfied). The term "nonaromatic carbocyclic ring system" denotes fully saturated carbocycles as well as partially or fully unsaturated carbocycles where the Hückel rule is not satisfied by any of the rings in the ring system. The term "aromatic

heterocyclic ring system" includes fully aromatic heterocycles and heterocycles in which at least one ring of a polycyclic ring system is aromatic (where aromatic indicates that the Hückel rule is satisfied). Examples of "aromatic heterocyclic ring systems" include furanyl, furazanyl, thienyl, pyrrolyl, pyrazolyl, oxazolyl, oxadiazolyl, imidazolyl, isoxazolyl, thiazolyl, thiadiazolyl, isothiazolyl, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl and triazinyl with said ring attached through any available carbon or nitrogen. For example, when the aromatic heterocyclic ring is furanyl, it can be 2-furanyl or 3-furanyl, for pyrrolyl, the aromatic heterocyclic ring is 1-pyrrolyl, 2-pyrrolyl or 3-pyrrolyl, for pyridyl, the aromatic ring is 2-pyridyl, 3-pyridyl or 4-pyridyl and similarly for other aromatic heterocyclic rings. The term "nonaromatic heterocyclic ring system" denotes fully saturated heterocycles as well as partially or fully unsaturated heterocycles where the Hückel rule is not satisfied by any of the rings in the ring system. The heterocyclic ring systems can be attached through any available carbon or nitrogen by replacement of a hydrogen on said carbon or nitrogen.

One skilled in the art will appreciate that not all nitrogen containing heterocycles can form *N*-oxides since the nitrogen requires an available lone pair for oxidation to the oxide; one skilled in the art will recognize those nitrogen containing heterocycles which can form *N*-oxides. One skilled in the art will also recognize that tertiary amines can form *N*-oxides. Synthetic methods for the preparation of *N*-oxides of heterocycles and tertiary amines are very well known by one skilled in the art including the oxidation of heterocycles and tertiary amines with peroxy acids such as peracetic and *m*-chloroperbenzoic acid (MCPBA), hydrogen peroxide, alkyl hydroperoxides such as *t*-butyl hydroperoxide, sodium perborate, and dioxiranes such as dimethyldioxirane. These methods for the preparation of *N*-oxides have been extensively described and reviewed in the literature, see for example: T. L. Gilchrist in *Comprehensive Organic Synthesis*, vol. 7, pp 748-750, S. V. Ley, Ed., Pergamon Press; M. Tisler and B. Stanovnik in *Comprehensive Heterocyclic Chemistry*, vol. 3, pp 18-20, A. J. Boulton and A. McKillop, Eds., Pergamon Press; M. R. Grimmett and B. R. T. Keene in *Advances in Heterocyclic Chemistry*, vol. 43, pp 149-161, A. R. Katritzky, Ed., Academic Press; M. Tisler and B. Stanovnik in *Advances in Heterocyclic Chemistry*, vol. 9, pp 285-291, A. R. Katritzky and A. J. Boulton, Eds., Academic Press; and G. W. H. Cheeseman and E. S. G. Werstiuk in *Advances in Heterocyclic Chemistry*, vol. 22, pp 390-392, A. R. Katritzky and A. J. Boulton, Eds., Academic Press.

The term "halogen", either alone or in compound words such as "haloalkyl", includes fluorine, chlorine, bromine or iodine. The term "1-2 halogen" indicates that one or two of the available positions for that substituent may be halogen which are independently selected. Further, when used in compound words such as "haloalkyl", said alkyl may be partially or fully substituted with halogen atoms which may be the

- same or different. Examples of "haloalkyl" include F_3C , $ClCH_2$, CF_3CH_2 and CF_3CCl_2 . The terms "haloalkenyl", "haloalkenyloxy", "haloalkenylthio", "haloalkenyloxyalkyl", "haloalkynyl", "haloalkynyloxy", "haloalkynyloxyalkyl", "haloalkoxy", "haloalkoxyalkyl", "haloalkylthio", "haloalkylsulfinyl", "haloalkylsulfonyl", and the like, are defined analogously to the term "haloalkyl".
- Examples of "haloalkenyl" include $(Cl)_2C=CHCH_2$ and $CF_3CH_2CH=CHCH_2$. Examples of "haloalkenyloxy" include $(Cl)_2C=CHCH_2O$ and $CF_3CH_2CH=CHCH_2O$. Examples of "haloalkenylthio" include $(Cl)_2C=CHCH_2S$ and $CF_3CH_2CH=CHCH_2S$. Examples of "haloalkenyloxyalkyl" include $(Cl)_2C=CHCH_2OCH_2$ and $CF_3CH_2CH=CHCH_2OCH_2$. Examples of "haloalkynyl" include $HC\equiv CCHCl$, $CF_3C\equiv C$, $CCl_3C\equiv C$ and $FCH_2C\equiv CCH_2$. Examples of "haloalkynyloxy" include $CF_3C\equiv CCH_2O$, $CCl_3C\equiv CCH_2O$ and $FCH_2C\equiv CCH_2O$. Examples of "haloalkynyloxyalkyl" include $CCl_3C\equiv CCH_2OCH_2$ and $FCH_2C\equiv CCH_2CH_2OCH_2$. Examples of "haloalkoxy" include CF_3O , CCl_3CH_2O , $HCF_2CH_2CH_2O$ and CF_3CH_2O . Examples of "haloalkoxyalkyl" include CF_3OCH_2 , $CCl_3CH_2OCH_2CH_2$, $HCF_2CH_2CH_2OCH_2$ and $CF_3CH_2OCH_2$. Examples of "haloalkylthio" include CCl_3S , CF_3S , CCl_3CH_2S and $ClCH_2CH_2CH_2S$. Examples of "haloalkylsulfinyl" include $CF_3S(O)$, $CCl_3S(O)$, $CF_3CH_2S(O)$ and $CF_3CF_2S(O)$. Examples of "haloalkylsulfonyl" include $CF_3S(O)_2$, $CCl_3S(O)_2$, $CF_3CH_2S(O)_2$ and $CF_3CF_2S(O)_2$.
- "Alkylcarbonyl" denotes alkyl substituted carbonyl. Examples of "alkylcarbonyl" include $CH_3C(=O)$ and $(CH_3)_2CHC(=O)$. "Alkoxy carbonyl" denotes alkoxy substituted carbonyl. Examples of "alkoxy carbonyl" include $CH_3OC(=O)$ and $(CH_3)_2CHOC(=O)$. "Alkylcarbonylamino" denotes alkylcarbonyl substituted on nitrogen. Examples of "alkylcarbonylamino" include $CH_3C(=O)NH$ and $CH_3CH_2C(=O)NH$.
- "Alkoxy carbonylamino" denotes alkoxy carbonyl substituted on nitrogen. Examples of "alkoxy carbonylamino" include $CH_3OC(=O)NH$ and $CH_3CH_2OC(=O)NH$.
- Examples of "trialkylsilyl" include $(CH_3)_3Si$ and $(CH_3)_3CSi(CH_3)_2$. "Trialkylsilylalkyl" denotes trialkylsilyl substitution on alkyl. Examples of "trialkylsilylalkyl" include $(CH_3)_3SiCH_2$, and $(CH_3)_3SiCH_2CH_2$.
- "Trialkylsilylalkynyl" denotes trialkylsilyl substitution on alkynyl. Examples of "trialkylsilylalkynyl" include $(CH_3)_3SiC\equiv C$ and $(CH_3CH_2)SiCH_2C\equiv C$. "Trialkylsilylalkoxyalkoxy" denotes trialkylsilyl substitution on alkoxy substituted in turn on alkoxy. Examples of "trialkylsilylalkoxyalkoxy" include $(CH_3)_3SiCH_2OCH_2O$ and $(CH_3)_3SiCH_2CH_2OCH_2O$.
- The total number of carbon atoms in a substituent group is indicated by the " C_i-C_j " prefix where i and j are numbers from 1 to 11. For example, C_1-C_3 alkylsulfonyl designates methylsulfonyl through propylsulfonyl; C_2 alkoxyalkyl designates CH_3OCH_2 ; C_3 alkoxyalkyl designates, for example, $CH_3CH(OCH_3)$,

$\text{CH}_3\text{OCH}_2\text{CH}_2$ or $\text{CH}_3\text{CH}_2\text{OCH}_2$; and C_4 alkoxyalkyl designates the various isomers of an alkyl group substituted with an alkoxy group containing a total of four carbon atoms, examples including $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_2$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2$. Examples of "alkylcarbonyl" include $\text{C}(\text{O})\text{CH}_3$, $\text{C}(\text{O})\text{CH}_2\text{CH}_2\text{CH}_3$ and $\text{C}(\text{O})\text{CH}(\text{CH}_3)_2$. Examples of "alkoxycarbonyl" include $\text{CH}_3\text{OC}(=\text{O})$, $\text{CH}_3\text{CH}_2\text{OC}(=\text{O})$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OC}(=\text{O})$, $(\text{CH}_3)_2\text{CHOC}(=\text{O})$ and the different butoxy- or pentoxycarbonyl isomers. In the above recitations, when a compound of Formula I is comprised of one or more heterocyclic rings, all substituents are attached to these rings through any available carbon or nitrogen by replacement of a hydrogen on said carbon or nitrogen.

10 When a compound is substituted with a substituent bearing a subscript that indicates the number of said substituents can exceed 1, said substituents (when they exceed 1) are independently selected from the group of defined substituents. Further, when the subscript indicates a range, e.g., $(\text{R})_{i-j}$, then the number of substituents may be selected from the integers between i and j inclusive.

15 When a group contains a substituent which can be hydrogen, for example R^4 , then, when this substituent is taken as hydrogen, it is recognized that this is equivalent to said group being unsubstituted. When a group is optionally substituted with a substituent, for example with R^7 , then, when the group is not substituted with that substituent, it is recognized that this is equivalent to said group having a hydrogen substituent.

20 Compounds used in this invention often can exist as one or more stereoisomers. The various stereoisomers include enantiomers, diastereomers, atropisomers and geometric isomers. One skilled in the art will appreciate that one stereoisomer may be more active and/or may exhibit beneficial effects when enriched relative to the other stereoisomer(s) or when separated from the other stereoisomer(s). (See, e.g., U.S. Provisional Patent Application Serial No. 60/057917 filed September 4, 1997, which is hereby incorporated by reference in its entirety.) Additionally, the skilled artisan knows how to separate, enrich, and/or to selectively prepare said stereoisomers. Accordingly, the present invention comprises compounds selected from Formula I, *N*-oxides and agriculturally suitable salts thereof. The compounds of the invention may be present as a mixture of stereoisomers, individual stereoisomers, or as an optically active form.

30 The salts of the compounds which may be used in the invention include acid-addition salts with inorganic or organic acids such as hydrobromic, hydrochloric, nitric, phosphoric, sulfuric, acetic, butyric, fumaric, lactic, maleic, malonic, oxalic, propionic, salicylic, tartaric, 4-toluenesulfonic or valeric acids. The salts of the compounds which may be used in the invention also include those formed with organic bases (e.g., pyridine, ammonia, or triethylamine) or inorganic bases (e.g., hydrides, hydroxides, or

carbonates of sodium, potassium, lithium, calcium, magnesium or barium) when the compound contains an acidic group such as a carboxylic acid or phenol.

The fungicidal compositions of this invention, in addition to comprising fungicidally effective amounts of the mixtures of the invention, also optionally comprise at least one of a surfactant, a solid diluent or a liquid diluent. The preferred compositions of the present invention are those which comprise the above preferred component (1) and component (2) compounds.

This invention also relates to a method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof, or to the plant seed or seedling, a fungicidally effective amount of the compositions of the invention (e.g., as a composition described herein). The preferred methods of use include those involving the above preferred compositions.

The bc_1 Complex Fungicides

Compounds of Formula II are known to have a fungicidal mode of action which inhibits the bc_1 complex. Methyl (E)-2-[[6-(2-cyanophenoxy)-4-pyrimidinyl]oxy]- α -(methoxyimino)benzeneacetate is described as a bc_1 complex inhibitor in *Biochemical Society Transactions* 1993, 22, 68S. Methyl (E)- α -(methoxyimino)-2-[(2-methylphenoxy)methyl]benzeneacetate is described as a bc_1 complex inhibitor in *Biochemical Society Transactions* 1993, 22, 64S. (E)-2-[(2,5-Dimethylphenoxy)methyl]- α -(methoxyimino)-N-methylbenzeneacetamide is described as a bc_1 complex inhibitor in *Biochemistry and Cell Biology* 1995, 85(3), 306-311.

The bc_1 complex is sometimes referred to by other names in the biochemical literature, including complex III of the electron transfer chain, and ubiquinone:cytochrome c oxidoreductase. It is uniquely identified by the Enzyme Commission number EC1.10.2.2. The bc_1 complex is described in, for example, *J. Biol. Chem.* 1989, 264, 14543-38; *Methods Enzymol.* 1986, 126, 253-71; and references cited therein.

The Sterol Biosynthesis Inhibitor Fungicides

The class of sterol biosynthesis inhibitors includes DMI and non-DMI compounds, that control fungi by inhibiting enzymes in the sterol biosynthesis pathway. DMI fungicides have a common site of action within the fungal sterol biosynthesis pathway; that is, an inhibition of demethylation at position 14 of lanosterol or 24-methylene dihydrolanosterol, which are precursors to sterols in fungi. Compounds acting at this site are often referred to as demethylase inhibitors, DMI fungicides, or DMIs. The demethylase enzyme is sometimes referred to by other names in the biochemical literature, including cytochrome P-450 (14DM). The demethylase enzyme is described in, for example, *J. Biol. Chem.* 1992, 267, 13175-79 and references cited therein. DMI fungicides fall into several classes: triazoles, imidazoles, pyrimidines,

piperazines and pyridines. The triazoles includes bromuconazole, cyproconazole, difenoconazole, diniconazole, epoxiconazole, fenbuconazole, fluquinconazole, flusilazole, flutriafol, hexaconazole, ipconazole, metconazole, penconazole, propiconazole, tebuconazole, tetraconazole, triadimefon, triadimenol, triticonazole and uniconazole. The imidazoles include clotrimazole, econazole, imazalil, isoconazole, miconazole and prochloraz. The pyrimidines include fenarimol, nuarimol and triarimol. The piperazines include triforine. The pyridines include buthiobate and pyrifenox. Biochemical investigations have shown that all of the above mentioned fungicides are DMI fungicides as described by K. H. Kuck, et al. in *Modern Selective Fungicides - Properties, Applications and Mechanisms of Action*, Lyr, H., Ed.; Gustav Fischer Verlag: New York, 1995, 205-258.

The DMI fungicides have been grouped together to distinguish them from other sterol biosynthesis inhibitors, such as, the morpholine and piperidine fungicides. The morpholines and piperidines are also sterol biosynthesis inhibitors but have been shown to inhibit later steps in the sterol biosynthesis pathway. The morpholines include aldimorph, dodemorph, fenpropimorph, tridemorph and trimorphamide. The piperidines include fenpropidin. Biochemical investigations have shown that all of the above mentioned morpholine and piperidine fungicides are sterol biosynthesis inhibitor fungicides as described by K. H. Kuck, et al. in *Modern Selective Fungicides - Properties, Applications and Mechanisms of Action*, Lyr, H., Ed.; Gustav Fischer Verlag: New York, 1995, 185-204.

Synergistic Effects

Fungicides that effectively control plant fungi, particularly wheat powdery mildew (*Erysiphe graminis*) and wheat foot rot (*Pseudocercospora herpotrichoides*), are in constant demand by growers. Combinations of fungicides are often used to facilitate disease control and to retard resistance development. Mixtures of fungicides may provide significantly better disease control than could be predicted based on the activity of the individual components. This synergism has been described as "the cooperative action of two components of a mixture, such that the total effect is greater or more prolonged than the sum of the effects of the two (or more) taken independently" (see Tames, P. M. L., *Neth. J. Plant Pathology*, (1964), 70, 73-80). It has been demonstrated that compositions containing compounds of Formula Ia and Formula IIa; Formula Ia and flusilazole; Formula Ia and tebuconazole; and Formula Ia, Formula IIa and flusilazole exhibit synergistic effects.

The presence of a synergistic effect between two active ingredients is established with the aid of the Colby equation (see Colby, S. R. In *Calculating Synergistic and Antagonistic Responses of Herbicide Combinations*, Weeds, (1967), 15, 20-22):

$$p = A + B - \left[\frac{A \times B}{100} \right]$$

Using the methods of the Colby, the presence of a synergistic interaction between two active ingredients is established by first calculating the predicted activity, p, of the mixture based on activities of the two components applied alone. If p is lower than the experimentally established effect, synergism has occurred. In the equation above, A is the fungicidal activity in percentage control of one component applied alone at rate x. The B term is the fungicidal activity in percentage control of the second component applied at rate y. The equation estimates p, the fungicidal activity of the mixture of A at rate x with B at rate y if their effects are strictly additive and no interaction has occurred.

The Colby equation for a three way mixture is

$$p = A + B + C + \frac{A \times B \times C}{10000} - \left[\frac{(A \times B) + (A \times C) + (B \times C)}{100} \right]$$

In this application, fungicidal activities provided by compositions of Formula Ia, Formula IIa, flusilazole and tebuconazole alone are compared with that of compositions of the compounds of Formula Ia and Formula IIa together, compositions of the compounds of Formula Ia and flusilazole together, compositions of the compounds of Formula Ia and tebuconazole together, and compositions of the compounds of Formula Ia, Formula IIa and flusilazole together. Based on the description of synergism developed by Colby, compositions of the present invention are considered to be synergistically useful. Accordingly, this invention provides an improved method of combating fungi, such as wheat powdery mildew (*Erysiphe graminis*), wheat leaf rust (*Puccinia recondita*), wheat foot rot (*Pseudocercospora herpotrichoides*) and/or wheat glume blotch (*Septoria nodorum*) in crops, especially cereals.

Compositions are provided in accordance with this invention which comprise proportions of component (1) and component (2) which are especially useful for controlling particular fungal diseases. For example, the compositions of this invention include those wherein the mole ratio of component (1) to component (2) is from about 30:1 to 1:30. These compositions are considered especially useful for controlling wheat powdery mildew (*Erysiphe graminis*), wheat leaf rust (*Puccinia recondita*), wheat foot rot (*Pseudocercospora herpotrichoides*) and/or wheat glume blotch (*Septoria nodorum*). Preferred component (1) compounds for these compositions include 6-bromo-3-propyl-2-propyloxy-4(3H)-quinazolinone; 6,8-diiodo-3-propyl-2-propyloxy-4(3H)-quinazolinone; and 6-iodo-3-propyl-2-propyloxy-4(3H)-quinazolinone; with 6-iodo-3-propyl-2-propyloxy-4(3H)-quinazolinone being particularly preferred.

Preferred component (2) compounds for these compositions include 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole and tebuconazole; with 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, fenpropimorph, flusilazole, epoxiconazole and propiconazole being particularly preferred. Preferably, the mole ratio of component (1) to component (2) for these compositions is from about 4:1 to 1:4. Example compositions of this type include compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one in a mole ratio of the compound of Formula Ia to the compound of Formula IIa of from about 4:1 to 1:4, compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and fenpropimorph in a mole ratio of the compound of Formula Ia to fenpropimorph of from about 1:1 to 1:10, compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and flusilazole in a mole ratio of the compound of Formula Ia to flusilazole of from about 15:1 to 1:15, compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and tebuconazole in a mole ratio of the compound of Formula Ia to tebuconazole of from about 30:1 to 1:30, and compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one; and flusilazole in a mole ratio of the compound of Formula Ia to the compound of Formula IIa plus flusilazole of from about 4:1 to 1:4 and the compound of Formula IIa to flusilazole has a mole ratio of from about 4:1 to 1:4.

This invention also provides a process for controlling at least one plant disease selected from wheat powdery mildew, wheat leaf rust, wheat foot rot, and wheat glume blotch which comprises applying to the plant or portion thereof to be protected, or to the plant seed or seedling to be protected, an effective amount of a fungicidal combination including component (1) and component (2) wherein the mole ratio of component (1) to component (2) is from about 30:1 to 1:30 (preferably from about 4:1 to 1:4). Component (1) can, for example, be applied at a rate of 0.2 g/ha or more. Typically component (1) is applied at a rate of 100 g/ha. Component (2) may be applied simultaneously (e.g., in the form of a composition comprising component (1) and component (2) in an appropriate mole ratio); or component (1) and component (2) can be applied separately in an appropriate mole ratio (e.g., as a tank mix).

Compositions wherein component (2) is selected from the group consisting of 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole and tebuconazole; and wherein the mole ratio of component (1) to component (2) is from about 4:1 to 1:10 are considered especially useful for controlling wheat powdery mildew. Preferred component (1) compounds for these compositions include 6-bromo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; 6,8-diiodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; and 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; with 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone being particularly preferred. Preferred component (2) compounds for these compositions include 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, fenpropimorph, flusilazole, epoxiconazole and propiconazole. Example compositions of this type include compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one in a mole ratio of the compound of Formula Ia to the compound of Formula IIa of from about 4:1 to 1:4, compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and fenpropimorph in a mole ratio of the compound of Formula Ia to fenpropimorph of from about 1:1 to 1:10, compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and flusilazole in a mole ratio of the compound of Formula Ia to flusilazole of from about 4:1 to 1:4, and compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one; and flusilazole in a mole ratio of the compound of Formula Ia to the total of the compound of Formula IIa plus flusilazole of from about 4:1 to 1:4 and a mole ratio of the compound of Formula IIa to flusilazole of from about 4:1 to 1:4.

This invention also provides a process for controlling wheat powdery mildew which comprises applying to the plant or portion thereof to be protected, or to the plant seed or seedling to be protected, an effective amount of a fungicidal combination including component (1) and component (2) wherein the mole ratio of component (1) to component (2) is from about 4:1 to 1:10 (preferably from about 4:1 to 1:4). Component (1) can, for example, be applied at a rate of 0.2 g/ha or more. Typically component (1) is applied at a rate of 100 g/ha. Component (2) may be applied

simultaneously (e.g., in the form of a composition comprising component (1) and component (2) in an appropriate mole ratio); or component (1) and component (2) can be applied separately in an appropriate mole ratio (e.g., as a tank mix).

Compositions wherein component (2) is selected from the group consisting of 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole and tebuconazole; and wherein the mole ratio of component (1) to component (2) is from about 30:1 to 1:30 are considered especially useful for controlling wheat leaf rust. Preferred component (1) compounds for these compositions include 6-bromo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; 6,8-diiodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; and 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; with 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone being particularly preferred being particularly preferred. Preferred component (2) compounds for these compositions include 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, epoxiconazole, flusilazole and tebuconazole; with flusilazole and epoxiconazole being particularly preferred. Preferably, the mole ratio of component (1) to component (2) for these compositions is from about 4:1 to 1:4. Example compositions of this type include compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and flusilazole in a mole ratio of the compound of Formula Ia to flusilazole of from about 15:1 to 1:15, compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and tebuconazole in a mole ratio of the compound of Formula Ia to tebuconazole from about 30:1 to 1:30.

This invention also provides a process for controlling wheat leaf rust which comprises applying to the plant or portion thereof to be protected, or to the plant seed or seedling to be protected, an effective amount of a fungicidal combination including component (1) and component (2) wherein the mole ratio of component (1) to component (2) is from about 30:1 to 1:30 (preferably from about 4:1 to 1:4). Component (2) can, for example, be applied at a rate of 12.5 g/ha or more. Typically component (2) is applied at a rate of 160 g/ha. Component (1) may be applied simultaneously (e.g., in the form of a composition comprising component (1) and component (2) in an appropriate mole ratio); or component (1) and component (2) can be applied separately in an appropriate mole ratio (e.g., as a tank mix).

Compositions wherein component (2) is selected from the group consisting of 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-

(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole and tebuconazole; and wherein the mole ratio of component (1) to component (2) is from about 15:1 to 1:15 are considered especially useful for controlling wheat foot rot. Preferred component (1) compounds for these compositions include 6-bromo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; 6,8-diiodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; and 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; with 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone being particularly preferred being particularly preferred. A particularly preferred component (2) compound for these compositions is flusilazole. Preferably, the mole ratio of component (1) to component (2) for these compositions is from about 4:1 to 1:4. Example compositions of this type include compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and flusilazole in a mole ratio of the compound of Formula Ia to flusilazole of from about 15:1 to 1:15.

This invention also provides a process for controlling wheat foot rot which comprises applying to the plant or portion thereof to be protected, or to the plant seed or seedling to be protected, an effective amount of a fungicidal combination including component (1) and component (2) wherein the mole ratio of component (1) to component (2) is from about 15:1 to 1:15 (preferably from about 4:1 to 1:4). Component (1) can, for example, be applied at a rate of 5 g/ha or more. Typically component (1) is applied at a rate of 100 g/ha. Component (2) may be applied simultaneously (e.g., in the form of a composition comprising component (1) and component (2) in an appropriate mole ratio); or component (1) and component (2) can be applied separately in an appropriate mole ratio (e.g., as a tank mix).

Compositions wherein component (2) is selected from the group consisting of 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole and tebuconazole; and wherein the mole ratio of component (1) to component (2) is from about 30:1 to 1:30 are considered especially useful for controlling wheat glume blotch. Preferred component (1) compounds for these compositions include 6-bromo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; 6,8-diiodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; and 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone; with 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone being particularly preferred being

particularly preferred. Preferred component (2) compounds for these compositions include flusilazole and tebuconazole; with flusilazole being particularly preferred. Preferably, the mole ratio of component (1) to component (2) for these compositions is from about 4:1 to 1:4. Example compositions of this type include compositions comprising 6-iodo-3-propyl-2-propyloxy-4(3H)-quinazolinone and tebuconazole in a mole ratio of the compound of Formula Ia to tebuconazole from about 30:1 to 1:30

This invention also provides a process for controlling wheat glume blotch which comprises applying to the plant or portion thereof to be protected, or to the plant seed or seedling to be protected, an effective amount of a fungicidal combination including component (1) and component (2) wherein the mole ratio of component (1) to component (2) is from about 30:1 to 1:30 (preferably from about 4:1 to 1:4). Component (2) can, for example, be applied at 12.5 g/ha or more. Typically component (2) is applied at a rate of 160 g/ha. Component (1) may be applied simultaneously (e.g., in the form of a composition comprising component (1) and component (2) in an appropriate mole ratio); or component (1) and component (2) can be applied separately in an appropriate mole ratio, e.g., as a tank mix.

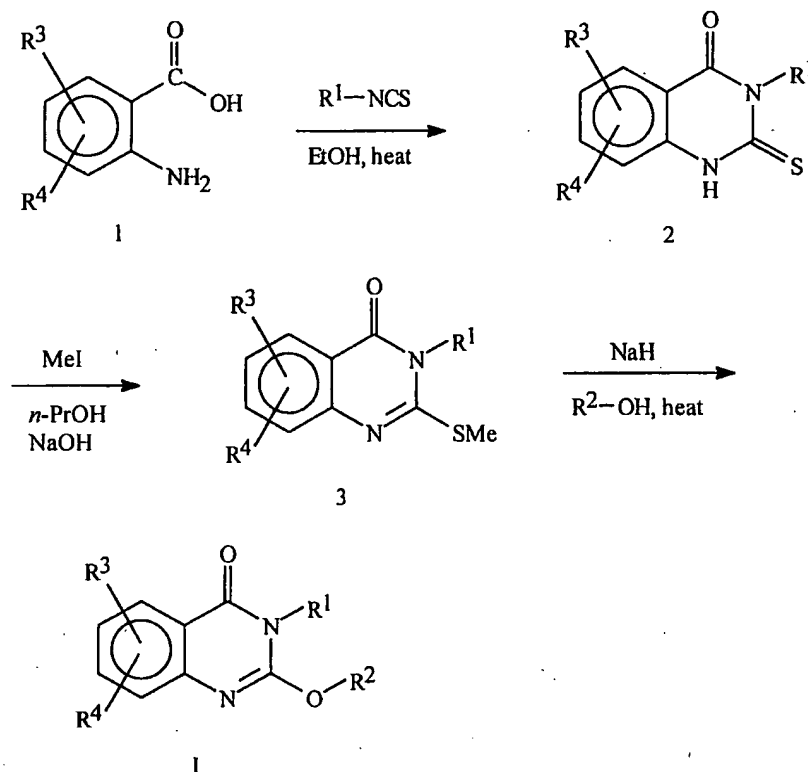
Synthesis of Compounds of Formula I

The compounds of Formula I where D is O can be prepared as described in International Patent Application WO 94/26722 and as shown in Scheme 1.

An anthranilic acid (2-aminobenzoic acid) of Formula 1 is condensed with an isothiocyanate of Formula $R^1\text{-NCS}$ to form the 2-thioquinazolinone of Formula 2. This condensation is preferably performed in the presence of a base such as triethylamine. S-Methylation of this compound affords the 2-methylthio-4(3H)-quinazolinone of Formula 3.

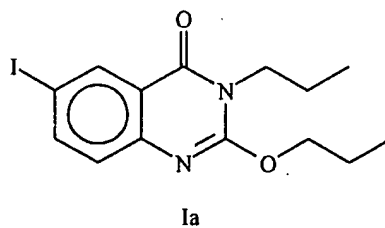
For the introduction of the $R^2\text{O}$ group, the 2-methylthio-4(3H)-quinazolinone of Formula 3 is treated with a mixture of a base, for example sodium hydride, in $R^2\text{OH}$ solvent. The reaction mixture is stirred at a temperature from about 0 °C to 120 °C for 1-120 hours. The desired 2- $R^2\text{O}$ -4(3H)-quinazolinone can be isolated from the reaction mixture by extraction into a water-immiscible solvent, and purified by chromatography or recrystallization. Similar synthetic procedures are described in U.S. 3,755,582, incorporated herein by reference.

Scheme 1



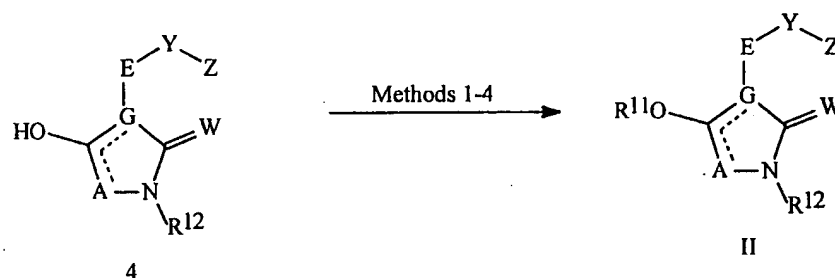
Anthranilic acids of Formula 1 are known or can be prepared by known methods. For example see, March, J. *Advanced Organic Chemistry*; 3rd ed., John Wiley: New York, (1985), p 983. The isothiocyanates of Formula $\text{R}^1\text{-NCS}$ can be prepared from the corresponding amine by treatment with thiophosgene as known in the art. For example, see *J. Heterocycl. Chem.*, (1990), 27, 407.

6-Iodo-3-propyl-2-propyloxy-4(3H)-quinazolinone, Formula Ia, is a compound of Formula I where D is O, R^1 is propyl, R^2 is propyl, R^3 is iodine fixed in the 6 position and R^4 is hydrogen.



Synthesis of Compounds of Formula II

Compounds of Formula II where Q is Q-1 and X is OR¹¹ can be prepared as described in International Patent Application WO 95/14009 by treating a compound of Formula 4 with an appropriate alkyl transfer reagent in an inert solvent with or without additional acidic or basic reagents or other reagents (Scheme 2). Suitable solvents are selected from the group consisting of polar aprotic solvents such as acetonitrile, dimethylformamide or dimethylsulfoxide; ethers such as tetrahydrofuran, dimethoxyethane, or diethyl ether; ketones such as acetone or 2-butanone; hydrocarbons such as toluene or benzene; and halocarbons such as dichloromethane or chloroform.

Scheme 2

Method 1: V-CH=N₂ (V = H or (CH₃)₃Si)

5

Method 2: ; Lewis acid

6

Method 3: (R¹¹)₃O⁺ BF₄⁻

7

Method 4: (R¹¹)₂SO₄; R¹¹OSO₂V; or R¹¹-hal;
optional base

(hal = F, Cl, Br, or I)

(V = C₁-C₆ alkyl, C₁-C₆ haloalkyl)

For example, compounds of Formula II where Q is Q-1 and X is OR¹¹ can be prepared by the action of diazoalkane reagents of Formula 5 such as diazomethane (V = H) or trimethylsilyldiazomethane (V = (CH₃)₃Si) on of Formula 4 (Method 1).

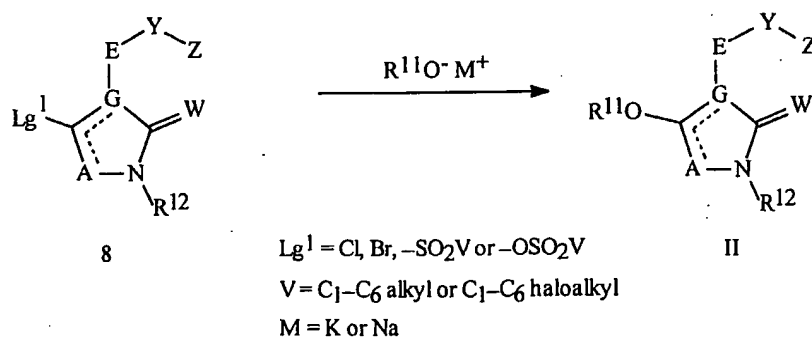
Use of trimethylsilyldiazomethane requires a protic cosolvent such as methanol. For examples of these procedures, see *Chem. Pharm. Bull.*, (1984), 32, 3759.

As indicated in Method 2, compounds of Formula II where Q is Q-1 and X is OR¹¹ can also be prepared by contacting compounds of Formula 4 with alkyl

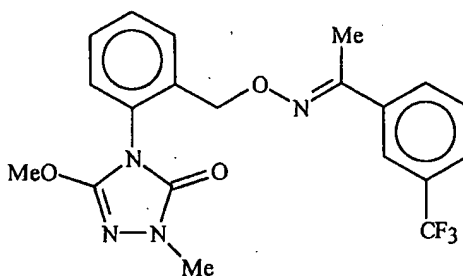
trichloroacetimidates of Formula 6 and a Lewis acid catalyst. Suitable Lewis acids include trimethylsilyl triflate and tetrafluoroboric acid. The alkyl trichloroacetimidates can be prepared from the appropriate alcohol and trichloroacetonitrile as described in the literature (J. Danklmaier and H. Hönig, *Synth. Commun.*, (1990), 20, 203).

- 5 Compounds of Formula II where Q is Q-1 and X is OR¹¹ can also be prepared from compounds of Formula 4 by treatment with a trialkyloxonium tetrafluoroborate (i.e., Meerwein's salt) of Formula 7 (Method 3). The use of trialkyloxonium salts as powerful alkylating agents is well known in the art (see U. Schöllkopf, U. Groth, C. Deng, *Angew. Chem., Int. Ed. Engl.*, (1981), 20, 798).
- 10 Other alkylating agents which can convert compounds of Formula 4 to compounds of Formula II where Q is Q-1 and X is OR¹¹ are dialkyl sulfates such as dimethyl sulfate, haloalkyl sulfonates such as methyl trifluoromethanesulfonate, and alkyl halides such as iodomethane and propargyl bromide (Method 4). These alkylations can be conducted with or without additional base. Appropriate bases include
- 15 alkali metal alkoxides such as potassium *tert*-butoxide, inorganic bases such as sodium hydride and potassium carbonate, or tertiary amines such as triethylamine, pyridine, 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU), and triethylenediamine. See R. E. Benson, T. L. Cairns, *J. Am. Chem. Soc.*, (1948), 70, 2115 for alkylation examples using agents of this type.
- 20 Compounds of Formula II where Q is Q-1 and X is OR¹¹ can also be prepared by reaction of Formula 8 compounds with alkali metal alkoxides (R¹¹O⁻M⁺) (Scheme 3). The leaving group Lg¹ in the amides of Formula 8 are any group known in the art to undergo a displacement reaction of this type. Examples of suitable leaving groups include chlorine, bromine, and sulfonyl and sulfonate groups. Examples of suitable
- 25 inert solvents are dimethylformamide or dimethylsulfoxide.

Scheme 3



2,4-Dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3H-1,2,4-triazol-3-one, Formula IIa, is a compound of Formula II where Q is Q-1, E is 1,2-phenylene, A is N, G is N with the floating double bond attached to A, W is O, X is OR¹¹, R¹¹ is CH₃,
 5 R¹² is CH₃, Y is -CHR²⁵O-N=C(R¹⁷)-, R¹⁷ is CH₃, R²⁵ is H, Z is phenyl substituted with R¹⁹ and R¹⁹ is CF₃ fixed in the 3 position.



IIa

Azoxystrobin, Formula IIb, is a compound of Formula II where Q is Q-2, E is 1,2 phenylene, W¹ is O, X¹ is C, Y is -O-, Z is 4,6-pyrimidinyl substituted with
 10 R¹⁹, R¹⁹ is phenoxy substituted with R²¹ and R²¹ is cyano fixed in the 2 position.

Kresoxim-methyl, Formula IIc, is a compound of Formula II where Q is Q-2, E is 1,2-phenylene, W¹ is O, X¹ is N, Y is -CHR²⁵O-, R²⁵ is H, Z is phenyl substituted with R¹⁹ and R¹⁹ is CH₃ fixed in the 2 position.

(*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, Formula IId, is a
 15 compound of Formula II where Q is Q-2, E is 1,2-phenylene, W¹ is NH, X¹ is N, Y is -O-, Z is phenyl substituted with R¹⁹ wherein R¹⁹ is H.

Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following Examples are, therefore, to be construed as merely illustrative.

20 Formulation/Utility

The fungicidal compositions of the present invention comprise an effective amount of a mixture of the compounds(s) of component (1) (e.g., 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone) and the compound(s) of component (2) (e.g., 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3H-1,2,4-triazol-3-one,
 25 kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole and/or tebuconazole). The mixtures of this invention will typically be used as a formulation or composition with an agriculturally suitable carrier comprising at least
 30 one of a liquid diluent, a solid diluent or a surfactant. The formulation or composition

ingredients are selected to be consistent with the physical properties of the active ingredient, mode of application and environmental factors such as soil type, moisture and temperature. Useful formulations include liquids such as solutions (including emulsifiable concentrates), suspensions, emulsions (including microemulsions and/or

5 suspoemulsions) and the like which optionally can be thickened into gels. Useful formulations further include solids such as dusts, powders, granules, pellets, tablets, films, and the like which can be water-dispersible ("wetttable") or water-soluble. Active ingredient can be (micro)encapsulated and further formed into a suspension or solid

10 (or "overcoated"). Encapsulation can control or delay release of the active ingredient. Sprayable formulations can be extended in suitable media and used at spray volumes from about one to several hundred liters per hectare. High-strength compositions are primarily used as intermediates for further formulation.

The formulations will typically contain effective amounts of active ingredients, diluent and surfactant within the following approximate ranges which add up to 100

15 percent by weight.

	Weight Percent		
	<u>Active Ingredients</u>	<u>Diluent</u>	<u>Surfactant</u>
Water-Dispersible and Water-soluble Granules, Tablets and Powders.	5-90	0-94	1-15
Suspensions, Emulsions, Solutions (including Emulsifiable Concentrates)	5-50	40-95	0-15
Dusts	1-25	70-99	0-5
Granules and Pellets	0.01-99	5-99.99	0-15
High Strength Compositions	90-99	0-10	0-2

Typical solid diluents are described in Watkins, et al., *Handbook of Insecticide Dust Diluents and Carriers*, 2nd Ed., Dorland Books, Caldwell, New Jersey. Typical liquid diluents are described in Marsden, *Solvents Guide*, 2nd Ed., Interscience, New

20 York, 1950. *McCutcheon's Detergents and Emulsifiers Annual*, Allured Publ. Corp., Ridgewood, New Jersey, as well as Sisely and Wood, *Encyclopedia of Surface Active Agents*, Chemical Publ. Co., Inc., New York, 1964, list surfactants and recommended uses. All formulations can contain minor amounts of additives to reduce foam, caking, corrosion, microbiological growth and the like, or thickeners to increase viscosity.

25 Surfactants include, for example, polyethoxylated alcohols, polyethoxylated alkylphenols, polyethoxylated sorbitan fatty acid esters, dialkyl sulfosuccinates, alkyl sulfates, alkylbenzene sulfonates, organosilicones, *N,N*-dialkyltaurates, lignin

sulfonates, naphthalene sulfonate formaldehyde condensates, polycarboxylates, and polyoxyethylene/polyoxypropylene block copolymers. Solid diluents include, for example, clays such as bentonite, montmorillonite, attapulgite and kaolin, starch, sugar, silica, talc, diatomaceous earth, urea, calcium carbonate, sodium carbonate and bicarbonate, and sodium sulfate. Liquid diluents include, for example, water, *N,N*-dimethylformamide, dimethyl sulfoxide, *N*-alkylpyrrolidone, ethylene glycol, polypropylene glycol, paraffins, alkylbenzenes, alkyl naphthalenes, oils of olive, castor, linseed, tung, sesame, corn, peanut, cotton-seed, soybean, rape-seed and coconut, fatty acid esters, ketones such as cyclohexanone, 2-heptanone, isophorone and 4-hydroxy-4-methyl-2-pentanone, and alcohols such as methanol, cyclohexanol, decanol and tetrahydrofurfuryl alcohol.

Solutions, including emulsifiable concentrates, can be prepared by simply mixing the ingredients. Dusts and powders can be prepared by blending and, usually, grinding as in a hammer mill or fluid-energy mill. Suspensions are usually prepared by wet-milling; see, for example, U.S. 3,060,084. Granules and pellets can be prepared by spraying the active material upon preformed granular carriers or by agglomeration techniques. See Browning, "Agglomeration", *Chemical Engineering*, December 4, 1967, pp 147-48, *Perry's Chemical Engineer's Handbook*, 4th Ed., McGraw-Hill, New York, 1963, pages 8-57 and following, and International Patent Publication WO 91/13546. Pellets can be prepared as described in U.S. Patent No. 4,172,714. Water-dispersible and water-soluble granules can be prepared as taught in U.S. Patent No. 4,144,050, U.S. Patent No. 3,920,442 and German Patent Application DE 3,246,493. Tablets can be prepared as taught in U.S. Patent No. 5,180,587, U.S. Patent No. 5,232,701 and U.S. Patent No. 5,208,030. Films can be prepared as taught in Great Britain Patent Application GB 2,095,558 and U.S. Patent No. 3,299,566.

For further information regarding the art of formulation, see U.S. Patent No. 3,235,361, Col. 6, line 16 through Col. 7, line 19 and Examples 10-41; U.S. Patent No. 3,309,192, Col. 5, line 43 through Col. 7, line 62 and Examples 8, 12, 15, 39, 41, 52, 53, 58, 132, 138-140, 162-164, 166, 167 and 169-182; U.S. Patent No. 2,891,855, Col. 3, line 66 through Col. 5, line 17 and Examples 1-4; Klingman, *Weed Control as a Science*, John Wiley and Sons, Inc., New York, 1961, pp 81-96; and Hance et al., *Weed Control Handbook*, 8th Ed., Blackwell Scientific Publications, Oxford, 1989.

In the following Examples, all percentages are by weight and all formulations are prepared in conventional ways.

Example AWettable Powder

	Active ingredient(s)	65.0%
	dodecylphenol polyethylene glycol ether	2.0%
5	sodium ligninsulfonate	4.0%
	sodium silicoaluminate	6.0%
	montmorillonite (calcined)	23.0%.

Example BGranule

10	Active ingredient(s)	10.0%
	attapulgit granules (low volatile matter, 0.71/0.30 mm; U.S.S. No. 25-50 sieves)	90.0%.

Example CExtruded Pellet

15	Active ingredient(s)	25.0%
	anhydrous sodium sulfate	10.0%
	crude calcium ligninsulfonate	5.0%
	sodium alkyl naphthalenesulfonate	1.0%
	calcium/magnesium bentonite	59.0%.

Example DEmulsifiable Concentrate

	Active ingredient(s)	20.0%
	blend of oil soluble sulfonates and polyoxyethylene ethers	10.0%
25	isophorone	70.0%.

The compounds of this invention are useful as plant disease control agents. The present invention therefore further comprises a method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof to be protected, or to the plant seed or seedling to be protected, an effective amount of a compound of the invention or a fungicidal composition containing said compound. The compounds and compositions of this invention provide control of diseases caused by a broad spectrum of fungal plant pathogens in the Basidiomycete, Ascomycete, Oomycete and Deuteromycete classes. They are effective in controlling a broad spectrum of plant diseases, particularly foliar pathogens of ornamental, vegetable, field, cereal, and fruit crops. These pathogens include *Plasmopara viticola*, *Phytophthora infestans*, *Peronospora tabacina*, *Pseudoperonospora cubensis*, *Pythium aphanidermatum*, *Alternaria brassicae*, *Septoria nodorum*, *Septoria tritici*, *Cercosporidium personatum*, *Cercospora arachidicola*, *Pseudocercospora herpotrichoides*, *Cercospora beticola*,

Botrytis cinerea, *Monilinia fructicola*, *Pyricularia oryzae*, *Podosphaera leucotricha*, *Venturia inaequalis*, *Erysiphe graminis*, *Uncinula necatur*, *Puccinia recondita*, *Puccinia graminis*, *Hemileia vastatrix*, *Puccinia striiformis*, *Puccinia arachidis*, *Rhizoctonia solani*, *Sphaerotheca fuliginea*, *Fusarium oxysporum*, *Verticillium dahliae*,
 5 *Pythium aphanidermatum*, *Phytophthora megasperma*, *Sclerotinia sclerotiorum*, *Sclerotium rolsii*, *Erysiphe polygoni*, *Pyrenophora teres*, *Gaeumannomyces graminis*, *Rhynchosporium secalis*, *Fusarium roseum*, *Bremia lactucae* and other genera and species closely related to these pathogens.

Mixtures of this invention can be further mixed with one or more other
 10 insecticides, fungicides, nematocides, bactericides, acaricides, growth regulators, chemosterilants, semiochemicals, repellents, attractants, pheromones, feeding stimulants or other biologically active compounds to form a multi-component pesticide giving an even broader spectrum of agricultural protection. Examples of such agricultural
 15 protectants with which compounds of this invention can be formulated are: insecticides such as abamectin, acephate, azinphos-methyl, bifenthrin, buprofezin, carbofuran, chlorfenapyr, chlorpyrifos, chlorpyrifos-methyl, cyfluthrin, beta-cyfluthrin, cyhalothrin, lambda-cyhalothrin, deltamethrin, diafenthiuron, diazinon, diflubenzuron, dimethoate, esfenvalerate, fenoxycarb, fenpropathrin, fenvalerate, fipronil, flucythrinate,
 20 tau-fluvalinate, fonophos, imidacloprid, isofenphos, malathion, metaldehyde, methamidophos, methidathion, methomyl, methoprene, methoxychlor, methyl 7-chloro-2,5-dihydro-2-[[N-(methoxycarbonyl)-N-[4-(trifluoromethoxy)phenyl]amino]carbonyl]indeno[1,2-e][1,3,4]oxadiazine-4a(3H)-carboxylate (DPX-JW062), monocrotophos, oxamyl, parathion, parathion-methyl, permethrin, phorate, phosalone, phosmet, phosphamidon, pirimicarb, profenofos,
 25 rotenone, sulprofos, tebufenozide, tefluthrin, terbufos, tetrachlorvinphos, thiodicarb, tralomethrin, trichlorfon and triflumuron; fungicides such as benomyl, blasticidin-S, Bordeaux mixture (tribasic copper sulfate), captan, carbendazim, chloroneb, chlorothalonil, copper oxychloride, copper salts, cymoxanil, cyprodinil (CGA 219417), diclomezine, dicloran, dimethomorph, dodine, edifenphos, famoxadone, fenpiclonil,
 30 fluazinam, flutolanil, folpet, fosetyl-aluminum, furalaxyl, iprobenfos, iprodione, isoprothiolane, kasugamycin, mancozeb, maneb, mepronil, metalaxyl, S-methyl 7-benzothiazolecarbothioate (CGA 245704), myclobutanil, neo-asozin (ferric methanearsonate), oxadixyl, pencycuron, probenazole, prochloraz, pyrifenoxy, pyroquilon, quinoxifen, spiroxamine (KWG4168), sulfur, thiabendazole,
 35 thiophanate-methyl, thiram, tricyclazole, validamycin and vinclozolin; nematocides such as aldoxycarb and fenamiphos; bactericides such as streptomycin; acaricides such as amitraz, chinomethionat, chlorobenzilate, cyhexatin, dicofol, dienochlor, etoxazole, fenazaquin, fenbutatin oxide, fenpropathrin, fenpyroximate, hexythiazox, propargite,

pyridaben and tebufenpyrad; and biological agents such as *Bacillus thuringiensis*, *Bacillus thuringiensis* delta endotoxin, baculovirus, and entomopathogenic bacteria, virus and fungi.

5 In certain instances, combinations with other fungicides having a similar spectrum of control but a different mode of action will be particularly advantageous for resistance management.

Plant disease control is ordinarily accomplished by applying an effective amount of the composition of this invention either pre— or post—infection, to the portion of the plant to be protected such as the roots, stems, foliage, fruit, seeds, tubers or bulbs, or to
10 the media (soil or sand) in which the plants to be protected are growing. The composition can also be applied to the seed to protect the seed and seedling.

Rates of application for this composition can be influenced by many factors of the environment and should be determined under actual use conditions. Foliage can normally be protected when treated at a rate of from less than 1 g/ha to 5,000 g/ha of
15 aggregate active ingredient. Aggregate active ingredient is defined as the total combined weight of active ingredients. Seed and seedlings can normally be protected when seed is treated at a rate of from 0.1 to 10 g of aggregate active ingredient per kilogram of seed.

The following Examples demonstrate the composition and method of the present
20 invention and provide experimental evidence for synergy between the compound of Formula Ia and flusilazole in preventative control of wheat leaf rust caused by *Puccinia recondita*, wheat foot rot caused by *Pseudocercospora herpotrichoides*, and wheat glume blotch caused by *Septoria nodorum*. The experimental also provides evidence for synergy between the compound of Formula Ia and tebuconazole in preventative
25 control of wheat leaf rust and wheat glume blotch. The experimental also provides evidence for synergy between the compound of Formula Ia and flusilazole in curative control of wheat powdery mildew caused by *Erysiphe graminis f. sp. tritici* and wheat leaf rust.

The experimental also provides evidence for synergy between the compounds of
30 Formula Ia, Formula IIa and flusilazole in preventative control of wheat foot rot. The experimental also provides evidence for synergy between the compounds of Formula Ia, IIa and flusilazole in curative control of wheat powdery mildew. The pathogen control protection afforded by these compositions is not limited, however, to these species.

The following TESTS demonstrate the control efficacy of compounds of this
35 invention on specific pathogens. The pathogen control protection afforded by the compounds is not limited, however, to these species.

BIOLOGICAL EXAMPLES OF THE INVENTION

Test compounds were first dissolved in acetone in an amount equal to 50% of the final volume and then suspended at a concentrations from 0.08 to 200 ppm in purified water containing 250 ppm of the surfactant Trem® 014 (polyhydric alcohol esters).

- 5 The resulting test suspensions were then used in the following test protocols. Spraying these test suspensions to the point of run-off on the test plants is the equivalent of a rate of 500 g/ha.

Protocol # 1 - WPM Preventive

- 10 The test compounds were sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore dust of *Erysiphe graminis* f. sp. *tritici*, (the causal agent of wheat powdery mildew). Seedlings were incubated in a growth chamber at 20 °C for 6 days, after which disease ratings were made.

Protocol # 2 - WPM Curative

- 15 Wheat seedlings were inoculated with a spore dust of *Erysiphe graminis* f. sp. *tritici*, (the causal agent of wheat powdery mildew). The following day a test compounds were sprayed to the point of run-off on and seedlings incubated in a growthchamber at 20 °C for 7 days, after which disease ratings were made.

Protocol # 3 WLR Preventive

- 20 The test compounds were sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore suspension of *Puccinia recondita* (the causal agent of wheat leaf rust) and incubated in a saturated atmosphere at 20 °C for 24 h, and then moved to a growth chamber at 20 °C for 6 days, after which disease ratings were made.

Protocol # 4 - WLR Curative

- 25 Wheat seedlings were inoculated with a spore suspension of *Puccinia recondita* (the causal agent of wheat leaf rust). The following day the test compounds were sprayed to the point of run-off on and incubated in a saturated atmosphere at 20 °C for 24 h, then moved to a growth chamber at 20 °C for 6 days, after which disease ratings were made.

- 30 Protocol # 5 - WFR Preventive

The test compounds were sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore suspension of *Pseudocercospora herpotrichoides* (the causal agent of wheat eye spot or wheat foot rot) and incubated in a saturated atmosphere at 20 °C for 72 h, and then moved to a growth chamber at 20 °C for 6 days, after which disease ratings were made.

Protocol # 6 - WGB Preventive

The test compounds were sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore suspension of *Septoria*

nodorum (the causal agent of wheat glume blotch) and incubated in a saturated atmosphere at 20 °C for 48 h, and then moved to a growth chamber at 20 °C for 6 days, after which disease ratings were made.

Protocol # 7 - WGB Curative

- 5 Wheat seedlings were inoculated with a spore suspension *Septoria nodorum* (the causal agent of wheat glume blotch). Two days later test compounds were sprayed to the point of run-off on and seedlings incubated in a saturated atmosphere at 20 °C for 48 h, then moved to a growth chamber at 20 °C for 6 days, after which disease ratings were made.

10 Protocol # 8 - WPM Preventative

The test suspension was sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore dust of *Erysiphe graminis f. sp. tritici*, (the causal agent of wheat powdery mildew) and incubated in a growth chamber at 20 °C for 7 days, after which disease ratings were made.

- 15 Results for protocols 1 - 8 are given in Tables A-G. In the tables, a rating of 100 indicates 100% disease control and a rating of 0 indicates no disease control (relative to the controls). An (nt) indicates no test results and (--) indicates no estimate of activity. In Tables A-G rates are given in parts per million (ppm) and/or grams active ingredient per hectare (g a.i./ha). The term "Actual" stands for the experimental value. The
20 abbreviation "Exp." stands for "Expected" (i.e., the predicted activity, p, from the Colby equation).

TABLE A
 Synergistic Effects of Compound Ia in Combination with Flusilazole, Tebuconazole and Prochloraz for Preventive Control of Wheat Powdery Mildew (WPM), Wheat Leaf Rust (WLR), Wheat Foot Rot (WFR) and Wheat Glume Blotch (WGB)

Test Cmpd 1	Test Cmpd 2	Rates (ppm)	Rates (g a.i./ha)	Mole Ratio	WPM ⁽¹⁾		WLR ⁽²⁾		WFR ⁽³⁾		WGB ⁽⁴⁾	
					Actual ⁽⁵⁾	Exp. ⁽⁶⁾	Actual	Exp.	Actual	Exp.	Actual	Exp.
Ia	--	0.08	0.2		100	-- ⁽⁷⁾	0	--	0	--	0	--
Ia	--	0.4	1		100	--	9	--	0	--	0	--
Ia	--	2	5		100	--	0	--	0	--	0	--
Ia	--	10	25		100	--	0	--	0	--	0	--
Flusilazole	--	0.08	0.2		90	--	18	--	16	--	0	--
Flusilazole	--	0.4	1		99	--	9	--	54	--	0	--
Flusilazole	--	2	5		100	--	88	--	45	--	0	--
Flusilazole	--	1	2.5		62	--	27	--	50	--	60	--
Flusilazole	--	5	12.5		35	--	79	--	100	--	83	--
Flusilazole	--	20	50		81	--	100	--	100	--	100	--
Flusilazole	Ia	0.08 + 0.08	0.2 + 0.2	1.18:1	100	100	9	18	0	16	0	0
Flusilazole	Ia	0.4 + 0.4	1 + 1	1.18:1	100	100	18	17	8	54	0	0
Flusilazole	Ia	2 + 2	5 + 5	1.18:1	100	100	88	88	100	45	0	0
Flusilazole	Ia	1 + 2	2.5 + 5	1:1.69	100	100	32	27	81	50	43	60
Flusilazole	Ia	5 + 2	12.5 + 5	2.95:1	nt ⁽⁸⁾	--	98	79	100	100	91	83
Flusilazole	Ia	20 + 2	50 + 5	11.81:1	nt	--	99	100	100	100	99	100

Percent Disease Control											
Test Cmpd 1	Test Cmpd 2	Rates (ppm)	Rates (g a.i./ha)	Mole Ratio	WPM ⁽¹⁾		WLR ⁽²⁾		WFR ⁽³⁾		WGB ⁽⁴⁾
					Actual ⁽⁵⁾	Exp. ⁽⁶⁾	Actual	Exp.	Actual	Exp.	
Flusilazole	Ia	1 + 10	2.5 + 25	1:8.47	nt	--	70	27	96	50	38 60
Flusilazole	Ia	5 + 10	12.5 + 25	1:1.69	nt	--	100	79	100	100	94 83
Flusilazole	Ia	20 + 10	50 + 25	2.36:1	nt	--	100	100	100	100	100 100
Tebuconazole	--	0.4	1		nt	--	32	--	nt	--	nt --
Tebuconazole	--	2	5		nt	--	100	--	nt	--	55 --
Tebuconazole	--	10	25		nt	--	100	--	nt	--	96 --
Tebuconazole	--	40	100		nt	--	nt	--	nt	--	100 --
Tebuconazole	Ia	0.4 + 2	1 + 5	1:4.13	nt	--	98	32	nt	--	-- --
Tebuconazole	Ia	2 + 2	5 + 5	1:1.21	nt	--	100	100	nt	--	59 55
Tebuconazole	Ia	10 + 2	25 + 5	6.06:1	nt	--	100	100	nt	--	100 96
Tebuconazole	Ia	40 + 2	100 + 5	24.23:1	nt	--		--	nt	--	100 100
Tebuconazole	Ia	0.4 + 10	1 + 25	1:20.63	nt	--	76	32	nt	--	nt --
Tebuconazole	Ia	2 + 10	5 + 25	1:4.13	nt	--	99	100	nt	--	84 55
Tebuconazole	Ia	10 + 10	25 + 25	1:1.21	nt	--	100	100	nt	--	100 96
Tebuconazole	Ia	40 + 10	100 + 25	4.85:1	nt	--	nt	--	nt	--	100 100
Prochloraz	--	0.4	1		nt	--	nt	--	37	--	nt --
Prochloraz	--	2	5		nt	--	nt	--	100	--	nt --
Prochloraz	--	10	25		nt	--	nt	--	100	--	nt --
Prochloraz	Ia	0.4 + 2	1 + 5	1:5	nt	--	nt	--	37	37	nt --
Prochloraz	Ia	2 + 2	5 + 5	1:1	nt	--	nt	--	100	100	nt --

<u>Test</u>	<u>Test</u> <u>Cmpd 1</u>	<u>Test</u> <u>Cmpd 2</u>	<u>Rates</u> <u>(ppm)</u>	<u>Rates</u> <u>(g a.i./ha)</u>	<u>Mole</u> <u>Ratio</u>	<u>Percent Disease Control</u>							
						<u>WPM⁽¹⁾</u>		<u>WLR⁽²⁾</u>		<u>WFR⁽³⁾</u>		<u>WGB⁽⁴⁾</u>	
						<u>Actual⁽⁵⁾</u>	<u>Exp. ⁽⁶⁾</u>	<u>Actual</u>	<u>Exp.</u>	<u>Actual</u>	<u>Exp.</u>	<u>Actual</u>	<u>Exp.</u>
Prochloraz	Ia	Ia	10 + 2	25 + 5	5:1	nt	--	nt	--	100	100	nt	--
Prochloraz	Ia	Ia	0.4 + 10	1 + 25	1:25	nt	--	nt	--	37	37	nt	--
Prochloraz	Ia	Ia	2 + 10	5 + 25	1:5	nt	--	nt	--	100	100	nt	--
Prochloraz	Ia	Ia	10 + 10	25 + 25	1:1	nt	--	nt	--	100	100	nt	--

(1) Wheat powdery mildew activity - Protocol #1

(2) Wheat leaf rust activity - Protocol # 3

(3) Wheat foot rot activity - Protocol # 5

(4) Wheat glume blotch activity - Protocol # 6

(5) Actual activity observed in the test

(6) Predicted activity

(7) No estimate - (--)

(8) Not tested (nt)

TABLE B
Synergistic Effects of Compound Ia in Combination with Flusilazole or Tebuconazole for Curative Control of Wheat Powdery Mildew (WPM),
Wheat Leaf Rust (WLR) and Wheat Glume Blotch (WGB)

<u>Test</u>	<u>Cmpd 1</u>	<u>Test</u>	<u>Cmpd 2</u>	<u>Rates</u> <u>(ppm)</u>	<u>Rates</u> <u>(g a.i./ha)</u>	<u>Mole</u> <u>Ratio</u>	<u>Percent Disease Control</u>					
							<u>WPM⁽¹⁾</u>		<u>WLR⁽²⁾</u>		<u>WGB⁽³⁾</u>	
							<u>Actual</u>	<u>Exp.</u>	<u>Actual</u>	<u>Exp.</u>	<u>Actual</u>	<u>Exp.</u>
	Ia	--	--	0.08	0.2		0	--	0	--	0	--
	Ia	--	--	0.4	1		56	--	0	--	0	--
	Ia	--	--	2	5		60	--	0	--	10	--
	Ia	--	--	10	25		nt	--	0	--	0	--
	Flusilazole	--	--	0.08	0.2		68	--	0	--	0	--
	Flusilazole	--	--	0.4	1		73	--	0	--	0	--
	Flusilazole	--	--	1	2.5		68	--	43	--	5	--
	Flusilazole	--	--	2	5		100	--	80	--	0	--
	Flusilazole	--	--	5	12.5		91	--	84	--	15	--
	Flusilazole	--	--	20	50		100	--	100	--	69	--
	Flusilazole	Ia	Ia	0.08 + 0.08	0.2 + 0.2	1.18:1	98	68	nt	--	nt	--
	Flusilazole	Ia	Ia	0.4 + 0.4	1 + 1	1.18:1	100	82	nt	--	nt	--
	Flusilazole	Ia	Ia	2 + 2	5 + 5	1.18:1	100	100	nt	--	nt	--
	Flusilazole	Ia	Ia	1 + 2	2.5 + 5	1:1.69	nt	--	15	43	0	15
	Flusilazole	Ia	Ia	5 + 2	12.5 + 5	2.95:1	nt	--	100	84	43	23
	Flusilazole	Ia	Ia	20 + 2	50 + 5	11.81:1	nt	--	99	100	71	72

Test		Percent Disease Control									
Cmpd 1	Cmpd 2	Test	Rates (ppm)	Rates (g a.i./ha)	Mole Ratio	WPM ⁽¹⁾		WLR ⁽²⁾		WGB ⁽³⁾	
						Actual	Exp.	Actual	Exp.	Actual	Exp.
Flusilazole	Ia	Ia	1 + 10	2.5 + 25	1:8.47	nt	--	71	43	0	0
Flusilazole	Ia	Ia	5 + 10	12.5 + 25	1:1.69	nt	--	100	84	29	15
Flusilazole	Ia	Ia	20 + 10	50 + 25	2.36:1	nt	--	100	100	81	69
Tebuconazole	--	--	0.4	1		nt	--	40	--	nt	--
Tebuconazole	--	--	2	5		nt	--	100	--	43	--
Tebuconazole	--	--	10	25		nt	--	100	--	50	--
Tebuconazole	--	--	40	100		nt	--	100	--	90	--
Tebuconazole	Ia	Ia	0.4 + 2	1 + 5	1:4.13	nt	--	100	40	nt	--
Tebuconazole	Ia	Ia	2 + 2	5 + 5	1:1.21	nt	--	100	100	29	49
Tebuconazole	Ia	Ia	10 + 2	25 + 5	6.06:1	nt	--	100	100	71	55
Tebuconazole	Ia	Ia	40 + 2	100 + 5	24.23:1	nt	--	100	100	90	91
Tebuconazole	Ia	Ia	0.4 + 10	1 + 25	1:20.63	nt	--	100	40	nt	--
Tebuconazole	Ia	Ia	2 + 10	5 + 25	1:4.13	nt	--	100	100	10	43
Tebuconazole	Ia	Ia	10 + 10	25 + 25	1:1.21	nt	--	100	100	71	50
Tebuconazole	Ia	Ia	40 + 10	100 + 25	4.85:1	nt	--	100	100	100	90

(1) Wheat powdery mildew - Protocol # 2

(2) Wheat leaf rust - Protocol # 4

(3) Wheat glume blotch - Protocol # 7

TABLE C
Synergistic Effects of Compound Ia in Combination with Compound IIa for Preventive Control of Wheat Powdery Mildew (WPM),
Wheat Leaf Rust (WLR), Wheat Foot Rot (WFR) and Wheat Glume Blotch (WGB)

Test Cmpd 1	Test Cmpd 2	Test Cmpd 3	Rates (ppm)	Rates (g a.i./ha)	Mole Ratio	WPM ⁽¹⁾		WLR ⁽²⁾		WFR ⁽³⁾		WGB ⁽⁴⁾	
						Actual	Exp.	Actual	Exp.	Actual	Exp.	Actual	Exp.
Ia	--	--	0.08	0.2		100	--	0	--	0	--	0	--
Ia	--	--	0.4	1		100	--	9	--	0	--	0	--
Ia	--	--	2	5		100	--	0	--	0	--	0	--
IIa	--	--	0.08	0.2		60	--	54	--	8	--	0	--
IIa	--	--	0.4	1		88	--	91	--	26	--	0	--
IIa	--	--	2	5		100	--	99	--	38	--	0	--
IIa	Ia	--	0.08 + 0.08	0.2 + 0.2	1:1.13	99	100	54	54	0	8	0	0
IIa	Ia	--	0.4 + 0.4	1 + 1	1:1.13	100	100	93	92	8	26	0	0
IIa	Ia	--	2 + 2	5 + 5	1:1.13	100	100	99	91	61	38	0	0

(1) Wheat powdery mildew activity - Protocol #1

(2) Wheat leaf rust activity - Protocol # 3

(3) Wheat foot rot activity - Protocol # 5

(4) Wheat glume blotch activity - Protocol # 6

TABLE D
 Synergistic Effects of Compound Ia in Combination with Compound IIa on Curative Control of Wheat Powdery Mildew (WPM),
 Wheat Leaf Rust (WLR) and Wheat Glume Blotch (WGB)

<u>Test</u> <u>Cmpd 1</u>	<u>Test</u> <u>Cmpd 2</u>	<u>Test</u> <u>Cmpd 3</u>	<u>Rates</u> <u>(ppm)</u>	<u>Rates</u> <u>(g a.i./ha)</u>	<u>Mole</u> <u>Ratio</u>	<u>Percent Disease Control</u>					
						<u>WPM⁽¹⁾</u>		<u>WLR⁽²⁾</u>		<u>WGB⁽³⁾</u>	
						<u>Actual</u>	<u>Exp.</u>	<u>Actual</u>	<u>Exp.</u>	<u>Actual</u>	<u>Exp.</u>
Ia	--	--	0.08	0.2		0	--	0	--	0	--
Ia	--	--	0.4	1		56	--	0	--	0	--
Ia	--	--	2	5		60	--	0	--	10	--
IIa	--	--	0.08	0.2		0	--	0	--	13	--
IIa	--	--	0.4	1		73	--	0	--	0	--
IIa	--	--	2	5		100	--	0	--	13	--
IIa	Ia	--	0.08 + 0.08	0.2 + 0.2	1:1.13	21	0	0	0	0	13
IIa	Ia	--	0.4 + 0.4	1 + 1	1:1.13	99	88	0	0	13	0
IIa	Ia	--	2 + 2	5 + 5	1:1.13	100	100	0	0	53	22

(1) Wheat powdery mildew - Protocol # 2

(2) Wheat leaf rust - Protocol # 4

(3) Wheat glume blotch - Protocol # 7

TABLE E
Synergistic Effects of Compound Ia / Compound IIa / Flusilazole combinations for Preventive Control of Wheat Powdery Mildew (WPM),
Wheat Leaf Rust (WLR), Wheat Foot Rot (WFR) and Wheat Glume Blotch (WGB)

Test	Test	Test	Rates	Mole	Percent Disease Control				WGB ⁽⁴⁾			
					WPM ⁽¹⁾		WLR ⁽²⁾		WFR ⁽³⁾		Actual	
Cmpd 1	Cmpd 2	Cmpd 3	(ppm)	Ratio	Actual	Exp.	Actual	Exp.	Actual	Exp.	Actual	Exp.
Ia	--	--	0.08	0.2	100	--	0	--	0	--	0	--
Ia	--	--	0.4	1	100	--	9	--	0	--	0	--
Ia	--	--	2	5	100	--	0	--	0	--	0	--
IIa	--	--	0.08	0.2	60	--	54	--	8	--	0	--
IIa	--	--	0.4	1	88	--	91	--	26	--	0	--
IIa	--	--	2	5	100	--	99	--	38	--	0	--
Flusilazole	--	--	0.08	0.2	90	--	18	--	16	--	0	--
Flusilazole	--	--	0.4	1	99	--	9	--	54	--	0	--
Flusilazole	--	--	2	5	100	--	88	--	45	--	0	--
Flusilazole	Ia	IIa	0.08 + 0.08 + 0.08	0.2 + 0.2 + 0.2	100	100	28	62	8	16	0	0
Flusilazole	Ia	IIa	0.4 + 0.4 + 0.4	1 + 1 + 1	100	100	93	100	62	54	0	0
Flusilazole	Ia	IIa	2 + 2 + 2	5 + 5 + 5	100	100	99	100	100	45	47	0

(1) Wheat powdery mildew activity - Protocol #1

(2) Wheat leaf rust activity - Protocol # 3

(3) Wheat foot rot activity - Protocol # 5

(4) Wheat glume blotch activity - Protocol # 6

TABLE F
Synergistic Effects of Compound Ia / Compound IIa / Flusilazole on Curative Control of Wheat Powdery Mildew (WPM),
Wheat Leaf Rust (WLR) and Wheat Glume Blotch (WGB)

Test Cmpd 1	Test Cmpd 2	Test Cmpd 3	Rates (ppm)	Rates (g a.i./ha)	Mole Ratio	Percent Disease Control					
						WPM ⁽¹⁾		WLR ⁽²⁾		WGB ⁽³⁾	
						Actual	Exp.	Actual	Exp.	Actual	Exp.
Ia	--	--	0.08	0.2		0	--	0	--	0	--
Ia	--	--	0.4	1		56	--	0	--	0	--
Ia	--	--	2	5		60	--	0	--	10	--
IIa	--	--	0.08	0.2		0	--	0	--	13	--
IIa	--	--	0.4	1		73	--	0	--	0	--
IIa	--	--	2	5		100	--	0	--	13	--
Flusilazole	--	--	0.08	0.2		68	--	0	--	0	--
Flusilazole	--	--	0.4	1		73	--	0	--	0	--
Flusilazole	--	--	2	5		100	--	80	--	0	--
Flusilazole	Ia	IIa	0.08 + 0.08 + 0.08	0.2 + 0.2 + 0.2	1.33:1.13:1	96	68	0	0	40	13
Flusilazole	Ia	IIa	0.4 + 0.4 + 0.4	1 + 1 + 1	1.33:1.13:1	100	100	0	0	0	0
Flusilazole	Ia	IIa	2 + 2 + 2	5 + 5 + 5	1.33:1.13:1	100	100	86	80	13	22

(1) Wheat powdery mildew - Protocol # 2

(2) Wheat leaf rust - Protocol # 4

(3) Wheat glume blotch - Protocol # 7

TABLE G

Synergistic Effects of Compound Ia in Combination with Fenpropimorph for Preventative Control of Wheat Powdery Mildew (WPM)⁽¹⁾

<u>Cmpd 1</u>	<u>Cmpd 2</u>	<u>Rates (g a.i./ha)</u>	<u>Mole Ratio</u>	<u>% Control of WPM⁽²⁾</u>				
				<u>Test 1</u>	<u>Test 2</u>	<u>Test 3</u>	<u>Mean</u>	<u>Exp.⁽³⁾</u>
Ia	--	20		100	100	100	100	-- ⁽⁴⁾
Ia	--	5		96	95	97	96	--
Ia	--	1		94	87	34	72	--
Fenpropimorph	--	100		79	76	80	78	--
Fenpropimorph	--	20		34	76	13	41	--
Fenpropimorph	--	5		0	nt ⁽⁵⁾	0	0	--
Fenpropimorph	Ia	100 + 20	6.1:1	100	100	100	100	100
Fenpropimorph	Ia	20 + 5	4.9:1	99	100	98	99	97.6
Fenpropimorph	Ia	5 + 1	6.1:1	92	nt	82	87	72
Untreated				19	31	52		

(% area diseased

Foliage)

(1) Wheat powdery mildew activity - Protocol #8

(2) Actual activity observed in the test

(3) Predicted activity

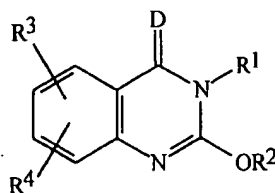
(4) No estimate - (--)

(5) Not tested (nt)

CLAIMS

What is claimed is:

1. A fungicidal composition comprising:
 - (1) at least one compound selected from the quinazolinones of Formula I,
 - 5 *N*-oxides, and agriculturally suitable salts thereof,



I

wherein

D is O or S;

- 10 R^1 is C_1 - C_{10} alkyl; C_3 - C_5 cycloalkyl; C_3 - C_{10} alkenyl; C_3 - C_{10} alkynyl;
 C_1 - C_{10} haloalkyl; C_3 - C_{10} haloalkenyl; C_3 - C_{10} haloalkynyl;
 C_2 - C_{10} alkoxyalkyl; C_2 - C_{10} alkylthioalkyl; C_2 - C_{10} alkylsulfinylalkyl;
 C_2 - C_{10} alkylsulfonylalkyl; C_4 - C_{10} cycloalkylalkyl;
 C_4 - C_{10} alkenyloxyalkyl; C_4 - C_{10} alkynyloxyalkyl; C_4 - C_{10}
 15 (cycloalkyl)oxyalkyl; C_4 - C_{10} alkenylthioalkyl; C_4 - C_{10} alkynylthioalkyl;
 C_4 - C_{10} (cycloalkyl)thioalkyl; C_2 - C_{10} haloalkoxyalkyl;
 C_4 - C_{10} haloalkenyloxyalkyl; C_4 - C_{10} haloalkynyloxyalkyl;
 C_4 - C_{10} alkoxyalkenyl; C_4 - C_{10} alkoxyalkynyl; C_4 - C_{10} alkylthioalkenyl;
 C_4 - C_{10} alkylthioalkynyl; C_4 - C_{10} trialkylsilylalkyl; C_1 - C_{10} alkyl substituted
 20 with NR^5R^6 , nitro, cyano or phenyl optionally substituted with R^8 , R^9 and
 R^{10} ; C_1 - C_{10} alkoxy; C_1 - C_{10} haloalkoxy; C_1 - C_{10} alkylthio;
 C_1 - C_{10} haloalkylthio; or pyridinyl, furanyl, thienyl, naphthalenyl,
 benzofuranyl, benzothienyl or quinolinyl each optionally substituted with
 R^8 , R^9 and R^{10} ;
- 25 R^2 is C_1 - C_{10} alkyl; C_3 - C_7 cycloalkyl; C_3 - C_{10} alkenyl; C_3 - C_{10} alkynyl;
 C_1 - C_{10} haloalkyl; C_3 - C_{10} haloalkenyl; C_3 - C_{10} haloalkynyl;
 C_2 - C_{10} alkoxyalkyl; C_2 - C_{10} alkylthioalkyl; C_2 - C_{10} alkylsulfinylalkyl;
 C_2 - C_{10} alkylsulfonylalkyl; C_4 - C_{10} cycloalkylalkyl;
 C_4 - C_{10} alkenyloxyalkyl; C_4 - C_{10} alkynyloxyalkyl; C_4 - C_{10}
 30 (cycloalkyl)oxyalkyl; C_4 - C_{10} alkenylthioalkyl; C_4 - C_{10} alkynylthioalkyl;
 C_4 - C_{10} (cycloalkyl)thioalkyl; C_2 - C_{10} haloalkoxyalkyl;
 C_4 - C_{10} haloalkenyloxyalkyl; C_4 - C_{10} haloalkynyloxyalkyl;
 C_4 - C_{10} alkoxyalkenyl; C_4 - C_{10} alkoxyalkynyl; C_4 - C_{10} alkylthioalkenyl;

C₄-C₁₀ alkylthioalkynyl; C₄-C₁₀ trialkylsilylalkyl; C₂-C₁₀ cyanoalkyl;
 C₁-C₁₀ nitroalkyl; C₁-C₁₀ alkyl substituted with CO₂R⁵, NR⁵R⁶, or phenyl
 optionally substituted with R⁷, R⁹ and R¹⁰; phenyl optionally substituted
 with R⁷, R⁹ and R¹⁰; -N=CR⁵R⁵; or -NR⁵R⁶; or

5 R¹ and R² are taken together to form -CH₂(CH₂)_qCH₂-;

q is 0, 1, 2, 3 or 4;

R³ is halogen, C₁-C₈ alkyl, C₃-C₈ cycloalkyl, C₂-C₈ alkenyl, C₂-C₈ alkynyl,
 C₁-C₈ haloalkyl, C₃-C₈ haloalkenyl, C₃-C₈ haloalkynyl, C₁-C₈ alkoxy,
 C₁-C₈ haloalkoxy, C₃-C₈ alkenyloxy, C₃-C₈ alkynyloxy, C₁-C₈ alkylthio,
 10 C₃-C₈ alkenylthio, C₃-C₈ alkynylthio, C₁-C₈ alkylsulfinyl, C₁-C₈
 alkylsulfonyl, C₂-C₈ alkoxyalkyl, C₂-C₈ alkylthioalkyl,
 C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₄-C₈ cycloalkylalkyl,
 C₃-C₈ trialkylsilyl, NR⁵R⁶, C₅-C₈ trialkylsilylalkynyl or phenyl optionally
 substituted with at least one R⁷;

15 R⁴ is hydrogen, halogen, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy or
 C₁-C₄ haloalkoxy;

each R⁵ is independently hydrogen, C₁-C₄ alkyl or phenyl optionally substituted
 with at least one R⁷;

each R⁶ is independently hydrogen, C₁-C₈ alkyl or phenyl optionally substituted
 20 with at least one R⁷; or

when R⁵ and R⁶ are attached to the same nitrogen atom, R⁵ and R⁶ can be taken
 together to form -CH₂CH₂CH₂CH₂-, -CH₂(CH₂)₃CH₂-,
 -CH₂CH₂OCH₂CH₂-, -CH₂CH(Me)CH₂CH(Me)CH₂- or
 -CH₂CH(Me)OCH(Me)CH₂-;

25 each R⁷ is independently halogen, C₁-C₄ alkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkyl,
 nitro or cyano;

R⁸ is C₁-C₆ alkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkyl, halogen, C₂-C₈ alkynyl,
 C₁-C₆ alkylthio, phenyl or phenoxy each optionally substituted with at least
 one R⁷, cyano, nitro, C₁-C₆ haloalkoxy, C₁-C₆ haloalkylthio, C₂-C₆
 30 alkenyl, C₂-C₆ haloalkenyl, acetyl, CO₂Me or N(C₁-C₂ alkyl)₂;

each R⁹ is independently methyl, ethyl, methoxy, methylthio, halogen or
 trifluoromethyl; and

each R¹⁰ is independently halogen;

(2) at least one compound selected from (a) compounds acting at the bc₁ complex
 35 of the fungal mitochondrial respiratory electron transfer site and (b) compounds that
 control fungal disease by inhibiting sterol biosynthesis; and optionally

(3) at least one of a surfactant, a solid diluent or a liquid diluent; wherein component (1) and component (2) are present in a fungicidally effective amount and the mole ratio of component (1) to component (2) is from about 30:1 to 1:30.

2. The fungicidal composition of Claim 1 comprising (1) at least one
5 compound selected from the group consisting of

6-bromo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone,
6,8-diiodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and
6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone;

and (2) at least one compound selected from the group consisting of
10 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-

(trifluoromethyl)phenyl]ethylidene]amino]oxy)methyl]phenyl]-3*H*-1,2,4-
triazol-3-one, kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-
methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole,
propiconazole and tebuconazole.

15 3. The fungicidal composition of Claim 2 comprising a fungicidally effective amount of (1) 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and (2) 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy)methyl]phenyl]-3*H*-1,2,4-triazol-3-one.

20 4. The fungicidal composition of Claim 2 comprising a fungicidally effective amount of (1) 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and (2) flusilazole.

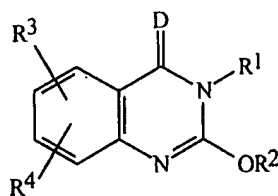
5. The fungicidal composition of Claim 2 comprising a fungicidally effective amount of (1) 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and (2) tebuconazole.

25 6. The fungicidal composition of Claim 2 comprising a fungicidally effective amount of (1) 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and (2) both 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy)methyl]phenyl]-3*H*-1,2,4-triazol-3-one; and flusilazole.

30 7. A method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof, or to the plant seed or seedling, a fungicidally effective amount of a composition of Claim 1.

8. A method of controlling at least one fungal plant disease selected from *Erysiphe graminis*, *Puccinia recondita*, *Pseudocercospora herpotrichoides* and *Septoria nodorum* comprising applying to the plant or portion thereof, or to the plant seed or seedling

35 (1) at least one compound selected from the quinazolinones of Formula I, *N*-oxides, and agriculturally suitable salts thereof,



I

wherein

D is O or S;

- 5 R^1 is C_1 - C_{10} alkyl; C_3 - C_5 cycloalkyl; C_3 - C_{10} alkenyl; C_3 - C_{10} alkynyl;
 C_1 - C_{10} haloalkyl; C_3 - C_{10} haloalkenyl; C_3 - C_{10} haloalkynyl;
 C_2 - C_{10} alkoxyalkyl; C_2 - C_{10} alkylthioalkyl; C_2 - C_{10} alkylsulfinylalkyl;
 C_2 - C_{10} alkylsulfonylalkyl; C_4 - C_{10} cycloalkylalkyl;
 C_4 - C_{10} alkenyloxyalkyl; C_4 - C_{10} alkynyloxyalkyl; C_4 - C_{10}
10 (cycloalkyl)oxyalkyl; C_4 - C_{10} alkenylthioalkyl; C_4 - C_{10} alkynylthioalkyl;
 C_4 - C_{10} (cycloalkyl)thioalkyl; C_2 - C_{10} haloalkoxyalkyl;
 C_4 - C_{10} haloalkenyloxyalkyl; C_4 - C_{10} haloalkynyloxyalkyl;
 C_4 - C_{10} alkoxyalkenyl; C_4 - C_{10} alkoxyalkynyl; C_4 - C_{10} alkylthioalkenyl;
 C_4 - C_{10} alkylthioalkynyl; C_4 - C_{10} trialkylsilylalkyl; C_1 - C_{10} alkyl substituted
15 with NR^5R^6 , nitro, cyano or phenyl optionally substituted with R^8 , R^9 and
 R^{10} ; C_1 - C_{10} alkoxy; C_1 - C_{10} haloalkoxy; C_1 - C_{10} alkylthio;
 C_1 - C_{10} haloalkylthio; or pyridinyl, furanyl, thienyl, naphthalenyl,
benzofuranyl, benzothienyl or quinolinyl each optionally substituted with
 R^8 , R^9 and R^{10} ;
- 20 R^2 is C_1 - C_{10} alkyl; C_3 - C_7 cycloalkyl; C_3 - C_{10} alkenyl; C_3 - C_{10} alkynyl;
 C_1 - C_{10} haloalkyl; C_3 - C_{10} haloalkenyl; C_3 - C_{10} haloalkynyl;
 C_2 - C_{10} alkoxyalkyl; C_2 - C_{10} alkylthioalkyl; C_2 - C_{10} alkylsulfinylalkyl;
 C_2 - C_{10} alkylsulfonylalkyl; C_4 - C_{10} cycloalkylalkyl;
 C_4 - C_{10} alkenyloxyalkyl; C_4 - C_{10} alkynyloxyalkyl; C_4 - C_{10}
25 (cycloalkyl)oxyalkyl; C_4 - C_{10} alkenylthioalkyl; C_4 - C_{10} alkynylthioalkyl;
 C_4 - C_{10} (cycloalkyl)thioalkyl; C_2 - C_{10} haloalkoxyalkyl;
 C_4 - C_{10} haloalkenyloxyalkyl; C_4 - C_{10} haloalkynyloxyalkyl;
 C_4 - C_{10} alkoxyalkenyl; C_4 - C_{10} alkoxyalkynyl; C_4 - C_{10} alkylthioalkenyl;
 C_4 - C_{10} alkylthioalkynyl; C_4 - C_{10} trialkylsilylalkyl; C_2 - C_{10} cyanoalkyl;
30 C_1 - C_{10} nitroalkyl; C_1 - C_{10} alkyl substituted with CO_2R^5 , NR^5R^6 , or phenyl
optionally substituted with R^7 , R^9 and R^{10} ; phenyl optionally substituted
with R^7 , R^9 and R^{10} ; $-N=CR^5R^5$; or $-NR^5R^6$; or
 R^1 and R^2 are taken together to form $-CH_2(CH_2)_qCH_2-$;

q is 0, 1, 2, 3 or 4;

R³ is halogen, C₁-C₈ alkyl, C₃-C₈ cycloalkyl, C₂-C₈ alkenyl, C₂-C₈ alkynyl, C₁-C₈ haloalkyl, C₃-C₈ haloalkenyl, C₃-C₈ haloalkynyl, C₁-C₈ alkoxy, C₁-C₈ haloalkoxy, C₃-C₈ alkenyloxy, C₃-C₈ alkynyloxy, C₁-C₈ alkylthio, C₃-C₈ alkenylthio, C₃-C₈ alkynylthio, C₁-C₈ alkylsulfinyl, C₁-C₈ alkylsulfonyl, C₂-C₈ alkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₄-C₈ cycloalkylalkyl, C₃-C₈ trialkylsilyl, NR⁵R⁶, C₅-C₈ trialkylsilylalkynyl or phenyl optionally substituted with at least one R⁷;

R⁴ is hydrogen, halogen, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy or C₁-C₄ haloalkoxy;

each R⁵ is independently hydrogen, C₁-C₄ alkyl or phenyl optionally substituted with at least one R⁷;

each R⁶ is independently hydrogen, C₁-C₈ alkyl or phenyl optionally substituted with at least one R⁷; or

when R⁵ and R⁶ are attached to the same nitrogen atom, R⁵ and R⁶ can be taken together to form -CH₂CH₂CH₂CH₂-, -CH₂(CH₂)₃CH₂-, -CH₂CH₂OCH₂CH₂-, -CH₂CH(Me)CH₂CH(Me)CH₂- or -CH₂CH(Me)OCH(Me)CH₂-;

each R⁷ is independently halogen, C₁-C₄ alkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkyl, nitro or cyano;

R⁸ is C₁-C₆ alkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkyl, halogen, C₂-C₈ alkynyl, C₁-C₆ alkylthio, phenyl or phenoxy each optionally substituted with at least one R⁷, cyano, nitro, C₁-C₆ haloalkoxy, C₁-C₆ haloalkylthio, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, acetyl, CO₂Me or N(C₁-C₂ alkyl)₂;

each R⁹ is independently methyl, ethyl, methoxy, methylthio, halogen or trifluoromethyl; and

each R¹⁰ is independently halogen; and

(2) at least one compound selected from (a) compounds acting at the bc₁ complex of the fungal mitochondrial respiratory electron transfer site and (b) compounds that control fungal disease by inhibiting sterol biosynthesis; wherein component (1) and component (2) are added in amounts sufficient to provide a fungicidal effectiveness greater than the sum of the fungicidal effectivenesses provided by those amounts of said components taken independently.

9. A method of Claim 8 wherein *Erysiphe graminis* is controlled; wherein component (1) is 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and component (2) is selected from the group consisting of 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one,

kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole and tebuconazole; and wherein the mole ratio of component (1) to component (2) is from 4:1 to 1:10.

- 5 10. A method of Claim 8 wherein at least one of *Puccinia recondita* and *Septoria nodorum* is controlled; wherein component (1) is 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and component (2) is selected from the group consisting of 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one,
- 10 kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole and tebuconazole; and wherein the mole ratio of component (1) to component (2) is from 30:1 to 1:30.
- 15 11. A method of Claim 8 wherein *Pseudocercospora herpotrichoides* is controlled; wherein component (1) is 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone and component (2) is selected from the group consisting of 2,4-dihydro-5-methoxy-2-methyl-4-[2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3*H*-1,2,4-triazol-3-one, kresoxim-methyl, azoxystrobin, (*E*)-2-(methoxyimino)-*N*-methyl-2-(2-phenoxyphenyl)acetamide, flusilazole, epoxiconazole, fenpropimorph, propiconazole
- 20 and tebuconazole; and wherein the mole ratio of component (1) to component (2) is from 15:1 to 1:15.

INTERNATIONAL SEARCH REPORT

Int. Classification No

PCT/US 98/01381

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 A01N43/54 //(A01N43/54, 61:00, 55:00, 47:38, 43:84, 43:653, 43:54, 37:50)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94 26722 A (DU PONT ; BEREZNAK JAMES FRANCIS (US); CHANG ZEN YU (US); SELBY THO) 24 November 1994 cited in the application see page 1, line 10 - page 4, line 23 see page 9, line 18 - line 23 see page 33, line 3 - line 8 see page 33, line 16 - line 27 see page 33, line 33 - line 35	1, 2, 4, 5, 7
Y	---	2, 6
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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